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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 2361, 2954, 3055, 3152, 3855, 4018, and 4316.

2170 (AE-332) ASPECTS OF LOW TEMPERATURE IRRADIATION IN NEUTRON ACTIVATION ANALYSIS. Brune, D. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Aug. 1968. 12p. Dep.

Neutron irradiation of the sample while frozen in a cooling device inserted in a reactor channel was carried out in the determination of iodine in aqueous samples as well as of mercury in biological tissues and water. For simultaneous irradiation of a large number of aqueous solutions the samples were arranged in a suitable geometry in order to avoid mutual flux perturbation effects. The influence of the neutron temperature on the activation process is discussed. Potential applications of the low-temperature irradiation technique are outlined. (auth) (Sweden)

2171 (AERE-AM-107) DETERMINATION OF HYDROGEN IN ZIRCONIUM ALLOYS BY HOT VACUUM EXTRACTION. Robinson, Marion (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 7p. Dep. CFSTI. UK 1s. 9d.

Samples weighing from 10 to 200 mg are introduced into a tantalum bucket at 1200°C suspended in a silica furnace tube under high vacuum. Liberated gases are transferred into a known volume, the pressure is measured, and the hydrogen content determined by difference after diffusion through a heated palladium thimble. From comparisons with vacuum fusion analyses, and intercomparison of standard samples with other laboratories, it was concluded that the error of this method does not exceed ±3 per cent. An estimate of the precision of the method was obtained from the results of 100 hydrogen determinations where the hydrogen concentrations varied from 20 to 1000 ppm. From the difference between duplicate determinations the coefficient of variation of a single determination was calculated to be ±4.8 per cent. (auth)(UK)

2172 (AERE-AM-108) THE DETERMINATION OF NITROGEN IN TITANIUM CARBIDE BY THE DUMAS TECHNIQUE. Hambridge, B. J.; Parker, A. (Atomic Energy Research Establishment, Harwell (England)). Aug. 1968. 8p. Dep. CFSTI. UK 2s. 6d.

The carbide is mixed with copper oxide and heated in two stages in a stream of CO_2 of high purity. The liberated nitrogen is collected, after purification, over 50% KOA solution and its volume measured. The method was applied to the determination of nitrogen in titanium carbide in which the nitrogen content varied between 0.1 and 1.5%. For this level of nitrogen content the sample weight taken for analysis is 50 to 200 mg. (auth) (UK)

2173 (EUR-4050) COULOMETRIC DETERMINATION OF THE WATER CONTENT OF URANIUM-PLUTONIUM OXIDE AND URANIUM OXIDE. Bartscher, W. J. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). May 21, 1968. 16p. (In German). Dep.

The determination of traces of water in uranium-plutonium oxide and uranium oxide is described. The sample is heated at 700°C and the water vapor evolved is passed into a phosphorus pentoxide-containing cell with the aid of a current of nitrogen. The phosphoric acid formed is electrolyzed and the amount of current necessary for this electrolysis is measured. From this amount the water content can be calculated. Results of this determination are given, and the calibration of the apparatus and of the method is described. (auth)

2174 (EURFNR-531) URANIUM AND PLUTONIUM DETERMINATION IN NUCLEAR FUEL SOLUTIONS BY X-RAY FLUORESCENCE ANALYSIS. Ertel, D.; Wettstein, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Translated from report KFK-747. 26p. (EUR-3728). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 44974.

2175 (K-Trans-44) ISOTOPE ANALYSIS OF URANIUM HEXAFLUORIDE WITH A HIGH ^{235}U ENRICHMENT. Chaussy, Louis; Boyer, Robert (Commissariat a l'Energie Atomique, Pierrelatte (France)). Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from report CEA-R-3337. 45p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 37643.

2176 (KFK-701) PROCEDURE FOR THE CHEMICAL ANALYTICAL DETERMINATION OF PLUTONIUM AND URANIUM IN OXIDIZED FUEL. Lindner, L.; Baeckmann, A. v. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Nov. 1967. 51p. (In German). (EUR-3714). Dep.

Procedures for the chemical determination of Pu and U in oxidized fuel which have been used for routine analysis for more than a year are described. For each method, the principle of the determination, the step-by-step procedure, and the possible interferences are described. The methods given are the dissolution of PuO_2 and PuO_2/UO_2, oxidimetric determination of U in phosphoric acid medium, cerimetric determination of equivalent amounts of U and Pu, cerimetric determination of Pu in addition to U and Fe, coulometric determination of Pu on the potential-controlled electrode, gravimetric determination of Pu in PuO_2, factor determination of the Ce(IV) sulfate solution with sodium oxalate, and preparation of a U/Pu solution for routine control. The reproducibility and validity of the methods are discussed. (J.S.R.)

2177 (KFK-819) SENSITIVE ELECTRICAL DIRECT DETERMINATION OF OXYGEN IN GASES AND LIQUID METALS APPLICABLE TO TECHNICAL USE AT HIGH TEMPERATURES. Sundermann, H.; Wagner, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Sept. 1968. 38p. (In German). Dep.

A direct electric measuring method was developed for determination of oxygen in gases and liquid metals. A measuring probe for laboratory use was designed. The reliability of the method was tested in various media for possible use in reactor circuits. (M.C.G.)

2178 (LA-DC-10034) NEW METHODS AND TECHNIQUES IN NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT. Keepin, G. Robert (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 25p. (CONF-681101-4). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Methods of detecting, identifying, and quantitatively analyzing fissionable materials in various practical configurations containing both fissionable and nonfissionable materials are discussed. Topics covered include: passive and active interrogation methods, parallel computational programs, detectors and sources, and practical assay applications. (M.C.G.)

2179 (NP-17554) THE DETERMINATION OF NITROUS ACID IN PUREX PROCESS SOLUTIONS. 1. DIRECT SPECTROPHOTOMETRIC DETERMINATION OF NITROUS ACID DISSOLVED IN TRIBUTYL PHOSPHATE PHASES. Markl, P.; Humblet, L.; Wichmann, P.; Eschrich, H. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Nov. 1967. 63p. (ETR-220). Dep. CFSTI.

Investigations performed on an extraction-spectrophotometric determination of nitrous acid in view of its application to Purex process solutions are described. Nitrous acid is extracted by tri-n-butyl phosphate (TBP), forming a 1:1 complex [TBP·HNO_2]. The high extractability of nitrous acid into TBP from low acid aqueous solutions allows selective separation from nitric acid and metal ions. The absorption spectrum of the [TBP·HNO_2] complex shows five absorption peaks in the wavelength region 335 to 400 m μ. Absorption measurements of the peak at 376.9 m μ (molar extinction coefficient = 100) permit the determination of nitrous acid in the range 5 to 200×10^{-4} M. The applicability of Beer's law to the various absorption peaks and the interferences caused by uranium, plutonium, dibutyl phosphate, and acidity have been studied. An effective stripping solution has been used for the removal of interfering species from the organic phase. The loss of nitrite due to the stripping procedure amounts to 4% and allowance can be made for this. The distribution of nitrous acid between TBP and $HClO_4$ phases and the stability of nitrous acid dissolved in 30% TBP solutions were determined. Absorption spectra of nitrous acid dissolved in dibutyl phosphate, tri-octyl phosphine oxide, tri-n-octylamine, and tri-n-octylamine oxide, in comparison with the [TBP·HNO_2] spectrum, are presented. A procedure, which gives results with a precision better than ±5%, is given for routine determinations of nitrous acid in organic and aqueous Purex process solutions. (auth)

2180 (NP-17617) SEPARATION OF IMPURITIES FROM PLUTONIUM BY EXTRACTION CHROMATOGRAPHY. Eschrich, H.; Hundere, I. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Mar. 1968. 29p. (ETR-222). Dep.

A procedure for separation of metal impurities from plutonium was developed to facilitate specification analyses for high-purity plutonium materials and the analysis of process solutions occurring in the final purification cycles of nuclear fuel reprocessing plants. Plutonium is quantitatively converted in a 5 to 7M nitric acid solution to the tetravalent oxidation state by addition of hydrogen peroxide and separated from its impurities by means of a chromatographic extraction column employing purified tributyl phosphate (TBP) supported by polytrifluoromonochloroethylene (Voltalef, 300 Micro PL) particles as the stationary phase and nitric acid of various molarities as the mobile phase. Plutonium (IV) is extracted into the TBP phase and thus retained on the column while most of the common impurities appear in the effluent on washing the column successively with 5, 3, and 1M nitric acid. The eluate containing the impurities is evaporated to a small volume (1 to 2 ml) and analyzed by suitable methods. Alternatively the eluate is evaporated to dryness, after removal of dissolved TBP by extraction into carbon tetrachloride, and redissolved in a medium better suited than nitric acid for subsequent quantitative determinations. More than 60 elements in the range of ppB to % of Pu can be separated from plutonium and recovered in a yield exceeding 90%. (auth)

2181 (NP-17619) DETERMINATION OF FLUORINE IN NUCLEAR FUEL REPROCESSING SOLUTIONS USING A FLUORIDE-SENSITIVE ELECTRODE. Moeken, H. H. Ph.; Eschrich, H.; Willeborts, G. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). May 1968. 19p. (ETR-190). Dep.

Procedures for determining the fluorine concentration in zirconium decladding (Zirflex) solutions, uranium feed solutions, and uranium final product solutions are described. The determinations are based on potential measurements of a fluoride-sensitive electrode versus a saturated calomel electrode after a relatively simple pretreatment of the sample as dilution, complexing of metal constituents or separation by a cation exchange column. (auth)

2182 (NP-17641) IN-LINE MEASUREMENTS BY COLORIMETRY. PART I. MEASUREMENTS OF ABSORPTION SPECTRA FOR THE DIRECT COLORIMETRIC DETERMINATION OF URANIUM. Markl, P.; Humblet, L.; Wichmann, H.; Eschrich, H. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Apr. 1966. 49p. (ETR-221). Dep.

The absorption spectra of uranium(VI) and uranium(IV) in aqueous nitric acid solutions and in 30% TBP–Shellsol-T solutions were established. The absorbance of the various solutions was measured as a function of the wavelength, uranium concentration, and nitric acid concentration. Most of the results obtained are presented in the form of diagrams. On the basis of the investigation the possibility of using a direct in-line colorimetric determination of uranium in plant solutions can be assessed at each individual measuring point. (auth)

2183 (NP-tr-1704) NUCLEAR METHODS OF DETERMINING BORON IN SILICON. Dragnev, T. N. Translated by C. R. Brightmore (Atomic Energy Research Establishment, Harwell, Eng.), from Compt. Rend. Acad. Bulg. Sci., 19: 711-14 (1966). 5p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 10261.

2184 (PNE-G-23) CHEMICAL ANALYSIS OF GASBUGGY ROCK. Hill, John H. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 4, 1968. 15p. Dep. CFSTI.

A compilation of chemical analyses of the pre-shot rock taken from the Gasbuggy site is presented. The data were used to predict the production and distribution of radionuclides and to correlate with the mineralogical analysis. Results of the various analyses are presented in an appendix. Pulverized samples were used for all determinations except free and bound H_2O. (auth)

2185 (NSJ-tr-134) MEASUREMENT OF THE ASH CONTENT IN COAL, USING TWO RADIATION SOURCES (^{137}Cs–^{241}Am). Fushimi, Hiromu. Translated from Genshiryoku Kogyo, 13: No. 6, 47-51(June 1967). 16p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 6263. (R.C.K.)

2186 (RISO-183) SEPARATION OF $^{59}Fe^{III}$ AND $^{59}Fe^{II}$ IN NEUTRON-ACTIVATED CRYSTALLINE FERROUS COMPOUNDS. Siekierska, K. E.; Fenger, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1968. 21p. Dep.

A method of separation of labelled $Fe^{(II)}$ and $Fe^{(III)}$ in heterogeneous systems is described. Electron exchange is avoided by formation of the ferrous dipyridyl complex followed by precipitation of ferric hydroxide. The effects of varying concentrations of the components have been examined. The possibilities of applying the method in hot-atom studies on ^{59}Fe in ferrous compounds are briefly discussed. (auth) (Denmark)

2187 (RT/CHI-(68)27) EXTRACTION OF THORIUM WITH THENOYLTRIFLUOROACETONE FROM A NITRATE SOLUTION OF IRRADIATED FUEL AND DIRECT SPECTROPHOTOMETRIC MEASUREMENT ON THE ORGANIC PHASE. Pompei, V.; Leo, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 30p. (In Italian). Dep.

A simple method is described that allows determination of thorium in the presence of other ions. The method is based on the thorium extraction with thenoyltrifluoroacetone and its direct spectrophotometric determination in the organic phase. The method is suitable for irradiated reactor power fuels. (auth)

2188 (RT/CHI-(68)29) DIRECT TITRIMETRIC AND POTENTIOMETRIC DETERMINATION OF THORIUM IN THE PRESENCE OF OTHER IONS. Altamura, V.; Canonico, A.; Pompei, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 35p. (In Italian). Dep.

A simple and rapid method is described for direct potentiometric determination of thorium with EDTA in the presence of other ions. The apparatus can be easily fixed for remote control and the method usefully employed for routine determinations for irradiated power reactor fuels. (auth)

2189 DETERMINATION OF FISSION GASES IN IRRADIATED URANIUM DIOXIDE. Chenebault, P.; Kurka, G.; Le Boulbin, E. (Centre d'Etudes Nucleaires, Grenoble, France). Nucl. Instrum. Methods, 65: 163-8(Nov. 1, 1968). (In French).

A method for the determination of fission gases in irradiated uranium dioxide is described. The samples are obtained by ultrasonic drilling at well defined positions of transverse sections of the cylindrical fuel element; then they are heat treated in an induction furnace up to 2300°C until complete evaporation. These two operations are performed in hot cells with remote handling. The gases are completely liberated by this treatment and collected ^{85}Kr is measured by gamma spectrometry and the other species by mass spectrometry. The knowledge of the quantities of fission gases lead to different results: by sampling in low temperature

regions of the fuel, burn up and flux anisotropies can be determined; and by sampling at different radial positions corresponding to different irradiation temperatures, the radial distribution and the fraction of released fission gases are known. (auth)

2190 ANALYTICAL APPLICATIONS OF HYDROXYCOUMARINS. Katyal, Mohan (St. Stephen's Coll., Delhi); Singh, H. B. Talanta, 15: 1043-54(Oct. 1968).

The analytical potentialities and physicochemical properties of hydroxycoumarins, including their application to the detection and determination of uranium, are reviewed. (auth) (UK)

2191 ACTIVATION ANALYSIS OF TRACE ELEMENTS IN HUMAN NAILS. I. SULFUR, PHOSPHORUS, AND CHLORINE. Shinbori, Yoshio; Inoue, Takeichiro. Sangyo Igaku, 10: 285-8 (May 1968). (In Japanese).

Sulfur, phosphorus and chlorine in the nails of two Japanese men and two Japanese women were determined by use of (n,γ) and (n,p) reactions. Sulfur and phosphorus were simultaneously determined by neutron activation analysis, and chlorine by 1.6 MeV gamma rays of 37.3 min (^{38}Cl). The results of sulfur were compared with those of conventional analysis by others. (NSA of Japan)

2192 SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM WITH 2,4,6-TRI(2'-PYRIDYL)-s-TRIAZINE. Embry, Wallace Abner. Austin, Tex., Univ. of Texas, 1968. 65p.

Thesis.

Ruthenium was found to react with 2,4,6-tri(2'-pyridyl)-s-triazine (TPTZ) when heated in a water–alcohol solution at a pH between 2.2 and 4.0. Spectra of these solutions were found to exhibit a maximum absorption at 510 millimicrons. The effects of heating temperature, heating time, reagent concentration, alcohol concentration, and pH were studied. Developed samples were stable for at least eight hours. The system conformed to Beer's law over the optimum concentration range of 1.1 to 3.9 ppM of ruthenium for measurement with a 1.00 cm optical path. Several cations interfered due to color development with the reagent. A distillation procedure for the separation of ruthenium from interferences was developed. A modification of the standard procedure was developed. The samples were developed according to the standard procedure; then hydrochloric acid was added and the absorbence read at 530 millimicrons. The optimum concentration range was found to be 0.9 to 3.1 ppM of ruthenium. Ion exchange studies showed that the complex was cationic. Spectrophotometric solution studies showed that TPTZ reacts with ruthenium to form a 2 to 1 complex. The complex was isolated as the iodide, perchlorate, and picrate. Elemental analysis also indicated a TPTZ to ruthenium ratio of 2 to 1. Infrared spectra of these compounds were obtained and compared with the spectra of the reagent and the iron (II) complex, a complex having a TPTZ to iron ratio of 2 to 1. (Diss. Abstr.)

2193 ABSORPTIOMETRIC DETERMINATION OF MOLYBDENUM AS THE COMPLEX WITH CATECHOL AND PAPAVERINE. Talipov, Sh. T.; Gor'kovaya, G. P.; Dzhiyanbaeva, R. Kh. Nauch. Tr. Tashkent. Gos. Univ., No. 284, 83-6(1967). (In Russian).

In the presence of catechol (I) and papaverine (II) in acid medium (optimum pH ≃ 1), Mo is extracted into $CHCl_3$ as a colored complex (ratio of Mo to I to II = 1 : 2 : 1) that is suitable for the absorptiometric determination of Mo. The absorption maximum of the extract is at 400 nm; the extinction is rectilinearly related to concentration with 0.5 to 6 μg of Mo per ml. The following do not interfere (tolerated amounts, relative to Mo, in parentheses)—Ni or Zn (200); Ti, V, Cu, U, or Th (100); Nb or $Cr^{(III)}$ (50); and Ta (20). To the test solution add 3 ml of 10% I solution, 1 ml of 0.5% II solution, and 2 drops of HCl (1 : 1), dilute to 10 ml, extract the complex into 10 ml of $CHCl_3$, and measure the extinction of the extract against $CHCl_3$. The error is <±4%; the sensitivity is 0.5 μg of Mo per ml. (Anal. Abstr.)

2194 ESTIMATION OF IODINE IN THYROIDAL AMINO ACIDS BY ALKALINE ASHING. Wilson, B. (Univ. of Cape Town); van Zyl, A. S. Afr. J. Med. Sci., 32: 70-82(Oct. 1967).

An accurate and reliable alkaline ashing method for the quantitative measurement of iodine in iodoamino acids resolved from thyroid hydrolysates by paper chromatography is described. The reproducibility of the method, recoveries of iodine, and factors influencing the reduction of Ce^{4+} by As^{3+} and iodine were investigated. The method was successfully used for determination of absolute specific activity of thyroidal amino acids in rat thyroids. Recoveries of inorganic and organic iodine were determined at different stages in the procedure. Based on the recoveries for iodide, iodotyrosines, and iodothyronines a mean loss of iodine of ~0.3% occurred during the drying period while the overall recovery for the method after incineration ranged from 97.58 to 99.49%. The method was applied to the determination of the iodine content and molar ratios of iodine-containing compounds in thyroids of rats maintained on a normal diet or iodine-deficient diet. The main difference between the 2 groups was found to be a significant reduction in the concentration of all iodoamino acid fractions in the thyroids of iodine-deficient rats. This reduction affected the diiodotyrosine (DIT) and thyroxine (T_4) concentrations to a greater extent than that of the monoiodotyrosine (MIT) and triiodothyronine (T_3), resulting in an increase of the MIT/DIT and T_3/T_4 ratios. (BBB)

2195 ANALYSIS OF HEAVY WATER BY THE FLOAT METHOD OVER THE ENTIRE CONCENTRATION RANGE. Gispert, M.; Rojas, J. L.; Echavarri, T.; Otero, J. L. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid, Ser. B, 63: 479-84(Apr. 1967). (In Spanish).

The float method is proposed for the determination of heavy water, which is suitable in the whole concentration range. The necessary data for calculating the calibration curves, as well as those for the particular case of the Pyrex glass float, are given. The theoretical errors are in reasonable agreement with the experimental ones. (auth)

2196 RADIOACTIVATION DETERMINATION OF RHENIUM BY USING AMPOULE NEUTRON SOURCES. Gureev, E. S.; Islamov, T.; Lobanov, E. M.; Miranskii, I. A.; Khaidarov, A. Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 4, 58-61 (1967). (In Russian).

The samples are irradiated in a paraffin block in the form of a cube of side 60 cm, in the center of which is a neutron source based on Po–Be or Ac–Be. The activity of the resulting ^{186}Re and ^{188}Re (half-life 3.87 days and 18.9 hr, respectively) is measured from the total γ-peak at 0.138 and 0.160 MeV, respectively, on a scintillation γ-spectrometer with a NaI(Tl) well-type crystal. With a Po–Be source, down to ≃1 ppM of Re can be determined after preliminary concentration, or 10 ppM of Re with radiochemical separation of the Re from an irradiated sample of 0.5 liter volume; with an Ac–Be source, 10 ppM of Re can be determined after preliminary concentration. A determination takes 2 to 4 hr. (Referationyi Zh.)

2197 ANODIC-STRIPPING VOLTAMMETRY OF TECHNETIUM. Astheimer, L.; Schwochau, K. (Kernforschungsanlage, Juelich, Ger.). J. Electroanal. Chem., 14: 240-1(1967). (In German).

In M-NaOH, $KTcO_4$ was electrolyzed at a hanging mercury drop at −1.0 V (vs a silver–AgCl electrode) for 4 min; anodic stripping was then carried out. Peaks were observed at −0.33 and −0.20 V, the former being suitable for determining Tc in concentrations from 0.1 mmoles to 0.3 μmoles, and the latter for the concentration range 0.1 mmole to 4 μmoles. Down to 0.3 μg of Tc in 20 ml of solution could be detected, and determined to within ±4%; 0.5 μg of Tc could be determined in the presence of a 10^4-molar excess of Mo(VI) or Re(VII), but U(VI) interfered. The mechanism of the electro-oxidation is discussed. (Anal. Abstr.)

2198 PREPARATION OF ANALYTICAL PRECIPITATES FOR X-RAY FLUORESCENCE ANALYSIS AND FOR β-RAY ACTIVITY MEASUREMENT. Bergner, K. G.; Kruse, C.-L. (Landesuntersuchungsanstalt, Stuttgart). Deut. Lebensm.-Rundsch., 63: 153-5(1967). (In German).

Detailed procedures are given for the preparation of precipitates of $SrCO_3$, by membrane filtration or by centrifuging after addition of a colloid. The latter method, with use of poly(vinyl alcohol), yields a quantitative homogeneous precipitate. The method is intended for application with foods. (Anal. Abstr.)

2199 PHOTOLUMINESCENCE OF RARE EARTH ELEMENTS IN Y_2O_3 AND THE APPLICATION FOR THEIR QUANTITATIVE ANALYSIS. Ozawa, Ryuji. Bunseki Kiki, 6: 108-17(Feb. 1968). (In Japanese).

The photoluminescences of microamounts of rare earth elements in Y_2O_3 were studied. Luminescence was detected for Pr, Sm, Eu, Gd, Tb, Dy, Ho, Er, and Tm. The luminescence and excitation spectrum varied largely with the respective elements. The luminescence intensity of the rare earth elements was directly proportional with the element concentration below 1×10^{-3} mole; this linear portion could be utilized for their quantitative analysis. The concentration limits for detection of the luminescences were from 10^{-9} to 10^{-7} mole, depending on the kind of rare earth element; for Gd and Sm, they were 10^{-5}. The photoluminescent technique was found to be suitable for the quantitative analysis of micro amounts of rare earth elements in high-purity Y_2O_3. (NSA of Japan)

2200 INDIRECT COMPLEXOMETRIC DETERMINATION OF MOLYBDENUM IN FERROMOLYBDENUM. Sucha, L. (Inst.

of Chemical Technology, Prague). Chem. Prumysl, 17: 324-6 (1967). (In Czech).

Dissolve the sample (0.1 to 0.7 g) in hot concentrated HCl (1 ml) and concentrated HNO_3 (a few drops), evaporate the acid, dissolve the residue in HCl (1 : 1) (10 ml), dilute with H_2O to 50 ml, and add to hot 10% NaOH solution. After 10 min filter off the precipitated $Fe(OH)_3$ and dilute the filtrate to a known volume. Dilute an aliquot with H_2O to 100 ml, add 10% hexamine solution (5 to 10 ml) and 0.2M-HNO_3, adjust the pH to 4.8 to 5.8, add xylenol orange solution (3 to 5 drops), boil, add 0.02M-$Pb(NO_3)_2$ dropwise until the solution becomes pink and then add an excess. Titrate with 0.02M-EDTA. (Anal. Abstr.)

2201 NEUTRON-ACTIVATION ANALYSIS FOR THE STUDY OF METALLOGENIC PROVINCES. Uken, Ernst A.; Santos, Gabriel G.; Wainerdi, Richard E. (Texas A and M Univ., College Station). Talanta, 15: 1097-1109(Nov. 1968).

The application of instrumental neutron activation analysis to the study of metallogenic provinces is outlined. Iron, scandium, and lanthanum were measured in uncrushed, whole-rock specimens, and the results indicated trace element compositional trends over the 50-mile traverse studied. These trends extended through a number of different formations and rock types, and reflect structural features mapped by conventional techniques. (auth) (UK)

2202 DETERMINATION OF HAFNIUM BY NEUTRON ACTIVATION, AND VARIATION IN THE Zr/Hf RATIO OF SOME GRANITE MASSES. Esson, J. (Univ. of Manchester, Eng.); Hahn-Weinheimer, P.; Johanning, H. Talanta, 15: 1111-18 (Nov. 1968).

A fairly quick method for the separation of hafnium from irradiated rock samples is described and results of the hafnium determinations are reported. The distribution of zirconium and hafnium and the variation of the Zr/Hf ratio in three calc-alkali granite masses are discussed. Reasons are suggested for the observed decrease in the Zr/Hf ratio during the crystallization of igneous rocks. (auth) (UK)

2203 PHOTON-ACTIVATION ANALYSIS FOR CARBON AND OXYGEN. Baker, C. A.; Williams, D. R. (Atomic Energy Research Establishment, Harwell, Eng.). Talanta, 15: 1143-51 (Nov. 1968).

A method is described for the determination of carbon and oxygen in organic materials by means of the reactions $^{12}C(\gamma,n)^{11}C$ and $^{16}O(\gamma,n)^{15}O$. Samples are irradiated with bremsstrahlung from a 32-MeV electron beam impinging on a tungsten target, and the active products are separated before the positron annihilation gamma rays are counted. Limits of detection of 0.003 μg of carbon and 0.1 μg of oxygen were obtained. (auth) (UK)

2204 USE OF NEUTRON-ENERGY MODERATION FOR RESOLVING INTERFERENCES IN FAST-NEUTRON ACTIVATION ANALYSIS. Pierce, T. B.; Edwards, J. W.; Haines, K. (Atomic Energy Research Establishment, Harwell, Eng.). Talanta, 15: 1153-8(Nov. 1968).

Vanadium, chromium, manganese, and iron, were determined in nickel-base samples after measurement of the intensity of two γ-lines: the 0.85 MeV γ-ray emitted by ^{56}Mn (produced from both Mn and Fe), and the 1.44-MeV γ-ray from ^{52}V (arising from V and Cr). The two elements contributing to each γ-peak were assayed separately from data obtained by irradiating each sample twice with neutrons of different energy distributions. (auth) (UK)

2205 NEW EXPERIMENTAL TECHNIQUE IN RADIOPOLAROGRAPHY. Almagro, V. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 305-8(Mar. 1968). (In Spanish).

The proposed experimental procedure is based on a semicontinuous measurement of the amalgamated drop activity of the deposited radioisotope. This technique may be used as an initial continuous one for automatic purposes. (auth)

2206 ISOTOPIC FRACTIONATION IN HAWAIIAN VOLCANIC GASES. Moore, Larry Joe. Honolulu, Hawaii, Univ. of Hawaii, 1968. 132p.

Thesis.

A complete mass spectrometer was constructed around a mass spectrometer tube originally designed by Nier. Modifications of this single collector device have permitted its use as a medium precision instrument in the determination of isotope abundances in carbon dioxide. A previous gas chromatograph design was modified to allow a one step separation and collection of carbon dioxide from a volcanic gas matrix, thus eliminating the usual and tedious volumetric method. To qualitatively predict the magnitude and direction of the isotopic fractionation in volcanic gases at higher temperatures (600 to 1500°K), equilibrium constants were calculated for numerous reactions involving carbon or oxygen isotope exchanges, such as $\frac{1}{2}C^{16}O_2 + H_2{}^{18}O = \frac{1}{2}C^{16}O_2 + H_2{}^{16}O$. The validity of these partition function calculations, which were based on Urey's simple harmonic approximations, was checked by comparison with similar calculations utilizing high temperature anharmonic corrections. Samples from a Hawaiian volcanic system were collected and analyzed for carbon and oxygen isotope abundances, in the form of carbon dioxide. Samples were taken from several areas, including fumarolic gases from Sulfur Bank in Kilauea Iki Crater, on Hawaii Island, gases from the drill holes in the lava lake of recently erupted Makaopuhi Crater, also on Hawaii, and assorted carbonaceous samples of marine origin. (Diss. Abstr.) (TSS)

2207 CALIBRATION OF A STANDARD SOLUTION OF IONIUM (^{230}Th). Acena Barrenechea, M. L.; Grau Malonda, A. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 563-70 (June 1968). (In Spanish).

An argon–methane 2π-flow counter was used to determine the absolute alpha activity of an ionium (^{230}Th) solution in 3.21N HNO_3. The samples to be counted were prepared on polished refractory steel planchets by evaporation of solution aliquots weighed according to the picnometer procedure. Self-absorption in the samples thus prepared is negligible as it was determined by means of pulse height analysis with a silicon-barrier detector. Crawford's theoretical equations were applied to calculate backscattering corrections. Results thus obtained were checked by activity measurements with a 4π-counter. The calibrated solution was stored in Pyrex glass ampules and no activity losses were noticed after 8 months. (auth)

2208 DETERMINATION OF ^{230}Th(IONIUM) IN ORES AND WASTES FROM URANIUM PROCESSING. II. RADIOCHEMICAL DETERMINATION OF THE NUCLIDE. Acena Barrenechea, M. L.; Galiano Sedano, J. A. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 551-62(June 1968). (In Spanish).

When the β-emitter ^{234}Th is used as tracer in the radiochemical determination of ^{230}Th (Ionium), two types of corrections should be applied in order to account for the counting contribution of other thorium isotopes present in the sample. These corrections were evaluated and checked experimentally. (auth)

2209 DETERMINATION OF ^{230}Th (IONIUM) IN ORES AND WASTES FROM URANIUM PROCESSING. I. CHEMICAL SEPARATION OF THE ELEMENT. Galiano Sedano, J. A.; Acena Barrenechea, M. L. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 545-50(June 1968). (In Spanish).

A method for the determination of ^{230}Th (Ionium), in uranium ores as well as in uranium processing wastes is described. The method is based on the alkaline fluxing of the solid samples with sodium peroxide followed by the precipitation of the element as fluoride, using La as a carrier. It is extracted subsequently with TTA and determined by alpha counting. The yield of the separation is determined with ^{234}Th beta-tracer. A yield of 92.03% was calculated exhibiting a standard deviation of ±4.27, which was found to be independent of the type of sample to be analyzed. (auth)

2210 ANALYSIS OF CERIUM(IV) PHOSPHATES AND PHOSPHATOSULFATES. Koenig, K.-H.; Meyn, E.; Eckstein, G. (Univ., Frankfurt am Main). Anal. Chim. Acta, 42: 540-2(Sept. 1968). (In German).

Procedures for the determination of Ce(IV) by reduction with As(III) and back-titration of excess reducing agent with Ce(III), photometric phosphate determination in Ce(IV) phosphate, and sulfate determination in sulfate-containing Ce(IV) phosphate solution were tested on solutions of known composition. The deviations from the known values are reported. (J.S.R.)

2211 STUDIES ON THE MUREXIDE COMPLEXES OF VANADIUM, THORIUM, AND CERIUM AND THEIR COLORIMETRIC DETERMINATION WITH MUREXIDE. Malik, W. U.; Ashraf, Y. (Univ. of Roorkee, India). J. Less-Common Metals, 16: 385-91(1968).

Complex formation of VO^{2+}, Th^{4+}, and Ce^{3+} with murexide was studied both spectrophotometrically and by pH titration. Use of the 1 : 1 colored complexes for analytical determination of the respective ions, and the effects of interfering ions, are discussed. (auth)

2212 ACTIVATION ANALYSIS [FOR IODINE IN BODY FLUIDS]. Comar, D.; le Poec, C. (to Commissariat a l'Energie Atomique). British Patent 1,103,995. Priority date Apr. 22, 1964, France.

The sample (1 ml) is irradiated for 30 min in a neutron flux of $\approx 5 \times 10^{12}$ thermal neutrons per cm^2 per sec, then carrier I^- ions are added, and I^-, Br^-, and Cl^- are adsorbed on a column of Dowex 2-X8 resin. The Cl^- and Br^- are eluted with aqueous $NaNO_3$, then I^- is eluted with hot aqueous $Mg(NO_3)_2$. The I^- in

the eluate is then oxidized to iodine, which is extracted into CCl_4, and subsequently reduced to I^- for β-counting. All these operations are carried out automatically in 22 min from the end of the irradiation. The sensitivity is 1 ng. (Anal. Abstr.)

2213 SEPARATION SCHEME FOR THE DETERMINATION OF ALKALI METALS (K, Rb, Cs), ALKALINE EARTHS (Sr, Ba) AND RARE EARTHS (Ce, Nd, Sm, Eu) IN SILICATE MATERIALS BY ISOTOPIC DILUTION ANALYSIS. Murugaiyan, P.; Verbeek, A. A.; Hughes, T. C.; Webster, R. K. (Atomic Energy Research Establisment, Harwell, Eng.). Talanta, 15: 1119-24(Nov. 1968).

A scheme is outlined for separation of Li, K, Rb, Cs, Sr, Ba, Ce, Nd, Sm, and Eu from silicate materials. The elements are separated by cation exchange to provide groups suitable for mass spectrometric analysis, and are then further purified by anion exchange. Results obtained by isotopic dilution analysis are reported for the standard rocks G-1, W-1, and the Barwell meteorite. In these measurements the alkali metals were determined separately from the other elements. Requirements are discussed for combining the procedures to form a more comprehensive method for use with a single sample. (auth) (UK)

2214 URANIUM AND THORIUM ABUNDANCES IN CHONDRITIC METEORITES. Morgan, J. W.; Lovering, J. F. (Australian National Univ., Canberra). Talanta, 15: 1079-95(Nov. 1968).

Neutron-activation analyses for uranium and thorium are reported for 42 chondrite meteorite "falls" and one "find" covering 15 of the 20 Van Schmus–Wood chondrite types. The mean uranium and thorium abundances of the 5 chemical groups showed a trend with C group (U = 0.012 atoms/10^6 Si atoms, Th = 0.045 atoms/10^6 Si atoms, Th/U = 3.78) > H, L and LL groups (U = 0.008, Th = 0.028, Th/U = 3.45) > E group (U = 0.005, Th = 0.021, Th/U = 3.69). With the possible exception of the C3 chondrites, the mean abundances for each petrologic type within a given chemical group were identical. (auth) (UK)

2215 ANALYSIS OF ZrO_2 STABILIZED BY YTTRIUM AND SCANDIUM OXIDES. Kolobova, K. K.; Yakovleva, V. S. Ogneupory, No. 10, 45-50(Oct. 1968). (In Russian).

A complexonometric method is described for determining the content of various oxides in ZrO_2 stabilized by yttrium and scandium oxides. The oxides determined are SiO_2, TiO_2, Sc_2O_3, Y_2O_3, Al_2O_3, Fe_2O_3, CaO, and MgO. (R.V.J.)

2216 GOLD–SILVER MINERALIZATIONS INVESTIGATED BY BORE-HOLE GEOPHYSICAL METHODS. Iordache, S. Gh. Stud. Cercet. Geol., Geofiz., Geogr., Ser. Geofiz., 5: 289-303 (1967). (In Rumanian).

Thermal neutron activation analysis was used in mineralogical considerations of silver ores. Interference reactions, which take place in bore-hole walls, are examined and the feasibility of silver evaluations when all other elements are present is claimed. Results obtained in holes drilled through gold-silver ores indicate the possibility of determining gold as well as other elements distributed in silver mineralizations. (Rom. Sci. Abstr.)

2217 DETERMINATION OF THE CONCENTRATION RATIO OF THE RADIONUCLIDES ^{144}Ce AND ^{137}Cs IN THE SOLID ATMOSPHERIC FALLOUT PRECIPITATED DURING THE 1964–66 WINTER SEASONS IN BUCHAREST. Voljin, V.; Ciudin, T. (Univ. of Bucharest). Stud. Cercet. Fiz., 20: 93-9(1968). (In Rumanian).

By means of γ spectroscopy, radiochemical, and chromatographic analyses the presence of the radionuclides ^{137}Cs, ^{144}Ce, $^{95}Zr(^{95}Nb)$, and $^{106}Ru(^{106}Rh)$ could be identified in the atmospheric fallout collected in Bucharest during the winter months of 1964–66; the results were similar to those observed during the previous 2 years. The specimens were collected by the previously used method: the water was filtered and evaporated to dryness at 250 to 300°C. The results indicated that the overall radioactivity decreased slightly but the activity due to radionuclides $^{95}Zr(^{95}Nb)$ and $^{106}Ru(^{106}Rh)$ became higher. The ratio of $^{144}Ce/^{137}Ce$ varied from 3.2 to 2.3, 2.3 and 1.7 from November 1964 to February 1965, respectively and from 2.1 to 2.1, 1.3 to 1.7 during the corresponding November 1965 to February 1966 period. The variations are probably due to meteorological factors. (TTT)

2218 CHEMICAL ANALYSIS OF CERAMIC MATERIALS, CONTAINING URANIUM AND PLUTONIUM, ARISING FROM THE DEVELOPMENT OF NUCLEAR FUELS. Milner, G. W. C.; Phillips, G.; Fudge, A. J. (Atomic Energy Research Establishment, Harwell, Eng.). Talanta, 15: 1241-57(Nov. 1968).

A comprehensive and critical review of analytical methods used in nuclear fuel technology is given, with 42 references. (auth) (UK)

2219 ACTIVATION ANALYSIS WITH STANDARDS CONTAINING TWO OR MORE ACTIVE NUCLIDES. A COMPUTERIZED METHOD OF CALCULATION INVOLVING DECAY AND GAMMA SPECTRAL RESOLUTION. Jenkins, W.; McMillan, J. W. (Atomic Energy Research Establishment, Harwell, Eng.). Talanta, 15: 1165-75(Nov. 1968).

The resolution of the gamma spectra of activities induced in materials by fast neutron, charged particle, and gamma photon activation is complicated by the fact that many elements produce more than one active nuclide in significant amounts. Direct resolution by least-squares fitting of the spectra of standards is only possible in these circumstances if the standard and sample spectra are obtained at the same time after irradiation, as the shapes of the standard spectra change with time. An alternative to the practical collection of spectra in this way is the correction of the standard spectra to the mid-time of counting of a sample spectrum. This may be achieved by recording spectra for a standard at different times and resolving the decay curves obtained for each channel on the basis of the half-lives of the component nuclides, which may be decay-independent or related or both. From the component nuclide count-rates in each channel at some arbitrary time, the standard spectrum at the time of counting of the sample can be generated and then used in a conventional least squares-fit of the sample spectrum. A FORTRAN IV program was written to carry out this type of calculation on an IBM 360/65 computer. The feasibility of using this method is demonstrated by its application to activation analyses involving standards containing decay-related and independent nuclides. (auth) (UK)

2220 PHYSICAL MEASUREMENTS FOR DETERMINING THE DEGREE OF PURITY OF MEDICAL ^{224}Ra (THORIUM X) PREPARATIONS. Schales, F.; Stahlhofen, W. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Atomkernenergie, 13: 433-6(Nov.-Dec. 1968). (In German).

In the course of determining the radiation dose from therapeutical applications of ^{224}Ra, the contamination by long-lived radionuclides of preparations used for intravenous injections was measured. For this purpose gamma-ray spectra of ampoules were registered, using a specially shielded well-type crystal arrangement. In the Whole-Body-Spectrometer of the Max Planck Institute for Biophysics a patient was analyzed, $12\frac{1}{2}$ years after treatment with 2.3 mCi of ^{224}Ra. For determining small amounts of alpha-emitting nuclides a method was evolved, wherein the material to be analyzed is mixed with the scintillator substance ZnS(Ag). Total alpha activity is obtained, and coincidence measurements of the double decay ^{220}Rn to ^{216}Po and ^{216}Po to ^{212}Pb permit separate determination of the ^{228}Th activity. This method was used to confirm the gamma measurements from the ampoules and to analyze a bone sample. In the mean ^{224}Ra preparations around 1950 contained about 5×10^{-5} Ci of ^{224}Ra and about 10^{-7} Ci of ^{226}Ra per Ci of ^{224}Ra. The preparations used today contain 1 to 2×10^{-7} Ci of ^{228}Th and about the same quantity of ^{226}Ra per Ci of ^{224}Ra. Noxious effects on patients from deposits of these long-lived substances seem negligible. (auth)

2221 GAMMA RAY SPECTROMETRY FOR THORIUM DETERMINATION IN SAND. Alam, B.; Ahmed, J. U.; Huq, M. S. Nucl. Sci. Appl., 4: 42-9(Apr. 1968).

Thirty-five sand samples from Chittagong sea coast from Cox's Bazar to Teknaf were analyzed by gamma spectrometry for detection and measurement of thorium. The gamma spectra obtained with a spectrometer consisting of a 3″ × 3″ NaI(Tl) crystal and a 512 channel analyzer showed the presence of thorium in most of the samples. The concentration of thorium in sand samples varied from 0.014 to 0.190%. (auth)

2222 DEUTERIUM ANALYSIS BY PHOTONEUTRON DETECTION. George, Kenneth D.; Kramer, Henry H. (Union Carbide Corp., Tuxedo, N. Y.). Trans. Amer. Nucl. Soc., 11: 474-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2223 TWO METHODS OF DETERMINING ppm QUANTITIES OF ^{236}Pu IN PuO_2. Tomlinson, F. K.; Smith, W. H.; Hagee, G. R.; Eppink, D. W. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc., 11: 458-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2224 DETERMINATION OF VERY LOW LEVELS OF HELIUM IN METALS. Farrar IV, Harry; Knox, Clifford H. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 503(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2225 RADIOMETRIC DETERMINATION OF TRACE FLUORIDE. Siegel, H. (Shell Development Co., Emeryville, Calif.). Trans. Amer. Nucl. Soc., 11: 468-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2226 NEUTRON ACTIVATION ANALYSIS WITH ^{252}Cf SOURCES. Ricci, Enzo; Handley, T. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 470 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2227 DEVELOPMENT AND EVALUATION OF POST-CUTTING CHIP ACTIVATION ANALYSIS METHODS IN THE STUDY OF TOOL WEAR. Prasad, K. N.; Jester, W. A. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc., 11: 471 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2228 RESONANCE SELF-INDICATION TECHNIQUE FOR ISOTOPIC ASSAY OF FISSILE MATERIALS. Menlove, H. O.; Thorpe, M. M.; Walton, R. B. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 659-60 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2229 DELAYED-NEUTRON KINETIC RESPONSE METHODS OF NONDESTRUCTIVE ASSAY. Augustson, R. H.; Menlove, H. O.; Henry, C. N.; Masters, C. F.; Keepin, G. R. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 660-1 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2230 APPLICATIONS OF NEUTRON INTERROGATION TO ASSAY OF FISSIONABLE MATERIAL. Thorpe, M. M.; Henry, C. N.; Smith, Darryl B.; Menlove, H. O.; Augustson, R. H. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 661 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2231 PRECISION OF NONDESTRUCTIVE NUCLEAR MATERIAL ASSAYS. Bramblett, R. L.; Gozani, T.; Ginaven, R. O.; McMillan, J. I. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 662 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2232 EXPERIMENTAL DETERMINATIONS OF LOW HYDROGEN DENSITIES WITH A NOTCHED SPECTRUM TECHNIQUE. Gavin, D. A.; Vought, R. H.; Slovacek, R. E. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 637-8 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2233 EXTRACTION: COMPLEXOMETRIC DETERMINATION OF GERMANIUM WITH USE OF DIANTIPYRINYLMETHANE. Zhivopistsev, V. P.; Selezneva, E. A.; Cherepanova, T. B. Uch. Zap., Perm. Gos. Univ., No. 141, 179-85(1966). (In Russian).

Extraction into $CHCl_3$ from 0.25N to 0.3N HCl medium in the presence of NH_4SCN and diantipyrinylmethane (I) can be used to remove Fe^{3+}, Cd, Co, Zn, Ti, Sn^{2+}, Mo(VI) and W(VI), and partially remove Mn^{2+}, Ni, Cu^{2+}, In, Ga, Tl^{3+}, Te, Bi, Sb^{3+}, and Pb, from germanium; subsequent extraction of the Ge from 4N HCl medium by the same reagents separates it from the elements remaining and also from Ca, Ba, Mg, and the alkali metals, and, in the presence of thiourea (II), from residual Cu, Bi, and Sb. Adjust the pH of the test solution to 5 to 6, add 2N HCl until its concentration is 0.25 to 0.3N (volume ≈25 ml), add 15 ml of $CHCl_3$, 2 g of NH_4SCN and 2 g of I, and shake the mixture for 15 to 20 min; then after 4 to 5 min separate the organic layer and repeat the extraction with 10 ml of $CHCl_3$ containing 1 g of NH_4SCN and 1 g of I. Wash the aqueous phase with $CHCl_3$ (3 × 5 or 6 ml) and to it add 12 to 13 ml of concentrated HCl, 1 g of II, 2 g of NH_4SCN, 15 ml of $CHCl_3$ and 2 g of I and extract the Ge (shaking for 15 to 20 min). After 1 or 2 min remove the organic layer, and to the aqueous phase add 1 g of NH_4SCN and 1 g of I, and repeat the extraction of Ge with 10 ml of $CHCl_3$. Wash the aqueous phase with $CHCl_3$ (3 × 5 or 6 ml), and re-extract the Ge from the combined extracts (2 × 15 to 20 ml of water, adding aqueous NH_3 to produce a pH of 2 to 3 in the aqueous phase). Then to the aqueous phase a add a 2- or 3-fold excess of 0.05M EDTA and 10 ml of 0.5N HCl, dilute to ≈100 ml and boil for 10 min. Cool, dilute to 100 ml, adjust the pH to 8 to 10 with aqueous NH_3, and titrate with $ZnSO_4$ solution in the presence of Eriochrome black T. (Anal. Abstr.)

2234 COMPLEXOMETRIC DETERMINATION OF SCANDIUM AFTER EXTRACTION OF ITS DIANTIPYRINYLMETHANE-NITRATE COMPLEX. Zhivopistsev, V. P.; Kalmykova, I. S. Uch. Zap., Perm. Gos. Univ., No. 141, 186-93(1966). (In Russian).

In weakly acid medium in the presence of NO_3^-, Sc^{3+} forms with diantipyrinylmethane (I) the ternary complex $[ScI_3](NO_3)_3$, which is readily extracted into $CHCl_3$ or dichloroethane. The optimum extraction conditions are acidity of medium, 0.65 to 0.75N in HCl (with HCl of >6N, extraction of Sc practically ceases); content of $NaNO_3$, 10 to 12%; and amount of I added, 1 to 2 g (the amount of I must be increased if the acidity is increased). Under these conditions (acidity 0.75N), Sc can be separated from ≈40 cations, including those of Al, Cd, Zn, Ga, and the rare-earth elements (Zr and Hf are masked with EDTA). Small amounts (fractions of a per cent) of Y and rare earths extracted with the Sc may be removed by washing the extract with dilute HNO_3 containing $NaNO_3$. To the test solution (15 to 25 ml), which should be 0.5N in HNO_3 or HCl and contain 1 to 30 mg of Sc, add 3 g of $NaNO_3$ and 2 g of I and extract with 15 ml of $CHCl_3$ (shaking for 10 to 15 min). Wash the extract with 15 ml of 20% $NaNO_3$ solution in 0.25N to 0.5N HCl, wash the aqueous layer with a little $CHCl_3$, and add the $CHCl_3$ to the main extract. Then add 10 ml of 25% aqueous NH_3 and an excess of 0.025M EDTA to the extract, shake for 20 to 25 min and, without separating the phases, titrate the unconsumed EDTA with 0.025M $ZnSO_4$ in the presence of 5-hydroxy-4-(2-hydroxyphenylazo)-3-methyl-1-(4-sulphophenyl)pyrazole to a color change from reddish orange to bright yellow. Eriochrome black T may also be used as indicator, but the final extract then has to be separated from the organic phase. (Anal. Abstr.)

2235 POSSIBLE USE OF METAL THIOCYANATE COMPLEXES OF DIANTIPYRINYLMETHANE FOR THE AMPEROMETRIC DETERMINATION OF CERTAIN ELEMENTS. Zhivopistsev, V. P.; Sadakov, G. A. Uch. Zap., Perm. Gos. Univ., No. 141, 174-8(1966). (In Russian).

An amperometric determination of W(VI) and Mo(VI) based on precipitation of the thiocyanate complexes of W and Mo with diantipyrinylmethane is presented. The titration is carried out with 0.02M diantipyrinylmethane in a basal solution of 2N to 3N H_2SO_4 (or, for Mo, N H_2SO_4 or HCl) containing >5% of SCN^-, from the current produced by reduction of the metal on a mercury-drop electrode at −1.2 vs the S.C.E. To prevent precipitation of tungstic or molybdic acid, the solution is acidified before addition of the NH_4SCN. For Mo, the titration must be carried out immediately after addition of the SCN^-. (Anal. Abstr.)

2236 ANALYSIS OF IRON OF HIGH PURITY. Albert, Philippe (Centre d'Etudes de Chimie Metallurgique, Vitry, France). Mem. Sci. Rev. Met., 65: Spec. No., 3-15(June 15, 1968). (In French).

From International Symposium on the New Physical, Mechanical and Chemical Properties of High Purity Iron, Paris, France. See CONF-660965.

Methods of analysis of pure iron by activation which were developed at the Vitry laboratory where they are used regularly are described. (a) After a long irradiation (~150 hours) with thermal neutrons, the radioisotopes of the impurities are isolated by numerous successive chemical separations, and it is thus possible to determine 45 elements with a great sensitivity. (b) Several elements are determined on a second metal sample irradiated for only 30 minutes. These are halogens some of whose radioisotopes have very short half-lives (18 minutes, 25 minutes, or 37 minutes). It is therefore not necessary to irradiate them longer, but on the other hand, the chemical separations have to be carried out very rapidly. (c) Aluminium and vanadium are determined by γ spectrometry without chemical separation after a very short irradiation (20 seconds). This sample can then be used to determine other elements. (d) Sulfur, phosphorus, platinum, and silicon are determined on other samples of the metal to be analyzed. Carbon, oxygen, and nitrogen, at the present time, are not determined by activation methods, but studies are in progress to develop the appropriate techniques. Comparisons of the results of activation analysis with those obtained by spark solid source mass spectrometry were carried out for several iron samples having different degrees of purity. These comparisons showed that the two methods are indeed complementary. Certain elements are determined more easily and with more precision, sensitivity and certainty by only one or the other of these methods. By using these two means of analysis and the gas determination methods (C,N,O) in pure metals by chromatography, it is certain that no impurity in the iron whose concentration might be of the order of 0.1×10^{-6} to some 10^{-6} depending on the elements, would be overlooked. The results of the activation and mass spectrometry analyses show that the purest iron samples contain from four to 7 ppM (10^{-6}) of impurities. At the present time, the sum of the detection limits of undetected elements by activation is of the order of 1 ppM. The main impurities of these highly pure irons are principally: 0.1 to 1.5 ppM of molybdenum,

0.2 to 1 ppM of nickel, 0.2 to 1 ppM of aluminium, 0.05 to 0.04 ppM of chromium, 0.007 to 0.5 ppM of phosphorus, 0.1 to 1 ppM of sulfur, 0.1 to 0.5 ppM of cobalt, 0.1 to 0.5 ppM of copper, 0.1 to 0.3 ppM of silicon, 0.02 to 0.1 ppM of manganese, 0.01 to 0.1 ppM of tungsten and sometimes 0.1 to 1 ppM of platinum. However, the results of the various carbon, oxygen, and nitrogen determinations are at the present time spread much wider apart from one sample to the next and these elements indeed seem to be the main impurities in very high purity iron. (auth)

2237 MODEL TANK INVESTIGATIONS TO CALIBRATE GROUNDWATER VELOCITY DETERMINATIONS BY THE POINT DILUTION METHOD. Ward, P. R. B.; Wurzel, P. (Agricultural Research Council, [Rhodesia], Africa). Atomkernenergie, 13: 449-54(Nov.-Dec. 1968).

Several series of field measurements of groundwater velocity in the Sabi alluvial plain have been undertaken, using the point dilution method with radioactive tracers. Field conditions, such as type of borehole casing and nature of packing, were sufficiently unique to require calibration. In the calibration measurements, velocities were determined in borehole casings whose diameters were two and six inches, and whose percentage perforations were 20 and 5%. A tank filling of fine to medium grained river sand graded to correspond with borehole samples was used, and conditions of gravel packing and no gravel packing were compared. The tests showed that velocities could be determined with a random error of ±15% in the six inch borehole and ±8% in the two inch borehole. At velocities greater than 3 ft/day, the measured velocities using the two inch instrument were found to fall considerably below the theoretical values. Contrary to the practical results by others in this field, a borehole lining of percentage perforation 5% was found to be adequate in sand of permeability 0.1 cm/sec. The filter velocity obtained did not necessitate correction for the permeability of the casing. (auth)

2238 REPORT OF THE GOVERNMENT CHEMIST, 1967. London, Her Majesty's Stationery Office, 1968. 232p. 22s. 6d.

Information is reported on the following topics: effects of irradiation on organophosphorus pesticides; fallout in drinking water and London rainwater; radiochemical analysis of Central Electricity Generating Board nuclear power station effluents; relationships between the masses of sub-atomic particles ("bachtamaid" theory of D. T. Lewis). (UK)

2239 PREPARATION OF SAMPLES FOR LIQUID SCINTILLATION ANALYSIS OF TRITIATED WATER IN BIOLOGICAL MATERIAL. Kumar, I.; Berger, E. Y. (Goldwater Memorial Hospital, New York). Int. J. Appl. Radiat. Isotop., 19: 805-7 (Nov. 1968).

The property of scintillation solutions to precipitate protein may be used to advantage in the analysis of tritiated water in solutions containing protein since the tritiated water remains in solution. Scintillation solution may be added directly to plasma, the mixture filtered or centrifuged, and aliquots from the filtrate or supernatant transferred to the scintillation vial for counting. The advantages over distillation or sublimation are self-evident, and the procedure avoids the errors and limitations of liquid scintillation counting of emulsions. Contaminating quenching or luminescent material may be removed by the addition of activated charcoal to the sample prior to the scintillation solution. (UK)

2240 RADIOACTIVE KRYPTONATES IN VOLUMETRIC ANALYSIS. PART 6. THE USE OF KRYPTONATES WITH ^{85}Kr GLASS AS THE INDICATOR IN NEUTRALIZATION TITRATION. Toelgyessy, J.; Siles, B.; Varga, S.; Jesenak, V. (Slowakische Technische Hochschule, Bratislava). Isotopenpraxis, 4: 368-71 (Sept. 1968). (In German).

A volumetric technique of determining acids by means of strong alkaline solutions using radioactive kryptonate of glass was developed. When the end point is passed an appropriate amount of ^{85}Kr is released as the result of the chemical destruction of the kryptonated glass surface. The titration technique is a discontinuous one. After addition of single doses of the titrant the residual activity of the indicator is measured. Radioactive kryptonate of glass is obtained by bombardment by accelerated ions of ^{85}Kr. (auth)

2241 DETERMINATION OF ^{131}I IN URINE. Dreyer, I.; Meyer, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis, 4: 374-6(Sept. 1968). (In German).

A method developed for the quantitative determination of ^{131}I in urine is based on the oxidative destruction of the organic constituents and simultaneous oxidation of the iodide to iodate by $KMnO_4$, reduction of the iodate to iodine by oxalic acid, distillation of the iodine and collection in H_2O, reduction of the iodine to iodide by sulfuric acid, gravimetric and radiometric determination of the iodide. The yield of carrier is 85%; standard deviation is ±4%. (auth)

2242 DETERMINATION OF MOLYBDENUM IN IRON AND STEEL WITH VACUUM SPECTROMETER. Goto, Hidehiro; Saito, Akira Sci. Rep. Res. Inst., Tohoku Univ., Ser. A, 20: 14-21(May 1968).

In the direct-reading spectrometric determination of molybdenum, the overlapping spectral lines of nickel and manganese often interfere with analytical results. Analytical lines of molybdenum, Mo II 2038.46 A and Mo II 2020.32 Å, are proposed, making use of iron line Fe II 1761.38 Å as an internal standard. With these spectral lines, interfering elements, excitation conditions, and reproducibility of the results were investigated. The best results were obtained under the excitation of the critically damped discharge of a low-voltage condenser spark. The overlapping line of manganese slightly interfered with Mo II 2038.46 Å. With Mo II 2020.32 Å, which had no interfering element. 0.20 and 1.09% of molybdenum in low-alloy steels were determined with the variation coefficients of 2.2 and 1.6%, respectively. (auth)

2243 SEPARATION OF SMALL AMOUNTS OF NIOBIUM FROM TITANIUM AND TANTALUM BY MEANS OF THE ANION EXCHANGER FROM ETHANOL–HYDROCHLORIC ACID SOLUTIONS. Kudritskaya, L. N.; Nabivanets, B. I. (Inst. of General and Inorganic Chemistry, Kiev). Zh. Anal. Khim., 23: 1643-6 (Nov. 1968). (In Russian).

A method was developed for separating small amounts of niobium (from 5 μg to 1.5 mg) from titanium and tantalum which is based on the different ion exchange-chromatographic behavior of Nb(V), Ti(IV) and Ta(V) in ethanol–hydrochloric acid solutions. Niobium is absorbed with the AV-17 anion exchanger from a mixture of 96% ethanol with 11.5 N HCl at a ratio of 4 : 6 (volume); titanium and tantalum pass into the eluate. The method was applied to the separation and photometric determination of not less than 0.01 and 0.001% of niobium in tantalum and titanium chlorides correspondingly. The relative error of the determinations is ±12%. (auth)

2244 SPECTRAL-ISOTOPIC METHOD FOR THE DETERMINATION OF GASES IN METALS BY MEANS OF A DIRECT CURRENT ARC. Ivanova, T. F.; Fedorov, V. V. Zh. Anal. Khim., 23: 1750-2(Nov. 1968). (In Russian).

By using a direct current arc into which stable isotopes are introduced as an internal reference, it is possible to determine nitrogen and oxygen in titanium, niobium, etc. The maximum sensitivity is 6×10^{-3} wt % for oxygen and 5×10^{-4} wt % for nitrogen. (auth)

2245 DETERMINATION OF IODINE AND BROMINE IN ORGANIC COMPOUNDS ON THE DECIGRAM SCALE. Selig, Walter (Univ. of California, Livermore). Z. Anal. Chem., 241: 251-5(1968).

Oxygen-bomb combustion is suggested for the decomposition of large samples of heterogeneous organic composites for the analysis of iodine and bromine. The micro method of Childs et al. (Microchem. J. 7: 266(1963)) has been scaled up for the determination of up to 200 mg of bromine; for the determination of similar amounts of iodine, however, addition of sodium hydroxide to the hydrazine sulfate absorbing solution was required for complete reduction. The method of decomposition has been found safe even for 1 g samples of high explosives. (auth)

2246 ALTERNATIVE COMBUSTION TECHNIQUE FOR TRITIUM SCINTILLATION COUNTING. Vickers, T. H. (Univ., Vienna). Anal. Chem., 40: 2219-20(Dec. 1968).

Methods are described for avoiding three specific problems that exist in the combustion technique for tritium scintillation counting. The three problems that exist are: firing the specimens is uncertain; liquid nitrogen for freezing the water of combustion is not always readily available; and a potentially appreciable amount of water, and therefore tritium, may be lost when vials are opened to introduce the scintillator solution. The first difficulty can be overcome by using India ink to blacken the carrier paper, followed after the ink has dried by a spot of 2 to 3% nitrocellulose (celloidin) in any volatile solvent. The second and third problems are interrelated and have been overcome by means of a deep freeze. (P.C.H.)

2247 SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF TANTALUM WITH VICTORIA BLUE B. Kirkbright, G. F.; Mayhew, M. D.; West, T. S. (Imperial Coll. of Science and Tech., London). Anal. Chem., 40: 2210-12(Dec. 1968).

The use of Victoria Blue B (Basic Blue 26, Colour Index 44045) in the spectrophotometric determination of microgram amounts of tantalum is described. Victoria Blue B forms a ternary complex with Ta and fluoride in $HCl - H_2SO_4$ medium. The complex is extractable into benzene. The complex has a somewhat higher molar absorptivity in benzene than the corresponding malachite green

and methyl violet complexes, and a selective determination of Ta is possible under the optimum conditions described. It was found that Ce(IV), Ce(V), NH_4^+, Hg(II), Th(IV), and $B_4O_7^{2-}$ interfere in the determination. (P.C.H.)

2248 ANALYSIS OF TRACE ELEMENTS IN AIR-BORNE PARTICULATES, BY NEUTRON ACTIVATION AND GAMMA-RAY SPECTROMETRY. Keane, J. R.; Fisher, E. M. R. (Atomic Energy Research Establishment, Harwell, Eng.). Atmos. Environ., 2: 603-14(Nov. 1968).

Neutron activation provides a direct method for determination of trace elements in air-borne particulate material collected on filters. By means of γ spectrometry, and utilizing computer techniques, the elements sodium, manganese, chlorine, vanadium, aluminium, bromine, and possibly copper and indium, may be determined simultaneously. A number of filter materials were analyzed for interfering trace elements. Teflon (P.T.F.E.) filters were found to have particularly low chlorine concentration in comparison with other materials examined. The esparto grass filters currently used at the nuclear weapon fallout sampling stations operated by A.E.R.E. Harwell have high trace impurity concentrations. Nevertheless, the volume of air filtered is so large that it was found possible to carry out a series of measurements using samples from these stations. Weekly samples from Chilton (Berks), Lerwick (Shetland), and Milford Haven (Pembs.) were collected and analyzed over periods of several months. Mean concentrations ($\mu g\ m^{-3}$) at Chilton for the year April 1965 to March 1966 were chlorine 2.2, manganese 0.033, sodium 0.85, aluminium 0.25, bromine 0.040, and vanadium 0.015. A small number of daily samples from Salford (Lancs.) indicated concentrations 2 to 10 times higher than those from Chilton. (auth) (UK)

2249 USE OF A LARGE QUARTZ SPECTROGRAPH FOR THE DETERMINATION OF THORIUM, YTTRIUM, AND THE RARE EARTHS IN SILICATES. Cohen, N. E.; Reeves, R. D.; Brooks, R. R. (Massey Univ., Palmerston North, New Zealand). Talanta, 15: 1449-56(Dec. 1968).

Studies were carried out on the optimum conditions for successful use of a large quartz spectrograph for determination of thorium, yttrium, and the rare earths in silicate rocks. The best line-to-background ratios were achieved by arcing samples in a matrix of 4% sodium chloride in carbon powder. An atmosphere of 20% argon and 80% oxygen was used to reduce background and eliminate cyanogen band interference. An anion-exchange procedure was used to separate the rare earths from other elements. The resultant enrichment allowed use to be made of less sensitive rare earth lines in the ultraviolet end of the spectrum, where the spectrographic dispersion is greater. Line interferences were studied and necessary corrections for these interferences were calculated. The technique was tested by analyzing the standard rocks, G-1, W-1, and CAAS syenite. Good agreement with recommended values was obtained. (auth) (UK)

2250 DETERMINATION OF ^{22}Na IN RAIN WATER BY USING A LOW-LEVEL β COUNTER. Burden, B. A. (Lab. of the Government Chemist, London). Analyst, 93: 715-19(Nov. 1968).

A method was developed for the separation from rain water of ^{22}Na, sufficiently radiochemically pure for it to be measured by low-level β counting. A 50-liter sample of rain water is evaporated to about 1 liter and the concentrate passed through a cation-exchange column. The sodium is eluted with 0.7 N hydrochloric acid solution. The sodium fraction is then purified, precipitated with α-methoxyphenylacetic acid, converted into sodium chloride, and counted in a low-background anticoincidence β counter. (auth) (UK)

2251 CRITICAL EVALUATION OF SPIKING OF LOW-GRADE ORE SAMPLES IN ACTIVATION ANALYSIS FOR GOLD AND URANIUM. de Lange, P. W.; de Wet, W. J.; Venter, J. H. (Atomic Energy Board, Pretoria). Talanta, 15: 1488-91(Dec. 1968).

In applying nondestructive neutron-activation analysis for gold and uranium in spiked low-grade ore samples, the following extrapolated unspiked concentrations were measured: 0.278 ± 0.015 ppM gold (chemical assay: 0.202 ± 0.020 ppM gold); 25.1 ± 1.1 ppM uranium (chemical assay value: 19.5 ± 2.0 ppM uranium). Different approaches to the fitting of results, and the influence of spiking nonuniformity, are discussed. (auth) (UK)

2252 DETERMINATION OF ALUMINIUM IN PLUTONIUM METAL BY DIFFERENTIAL LINEAR SWEEP OSCILLOGRAPHIC POLAROGRAPHY. Plock, C. E.; Vasquez, J. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Talanta, 15: 1391-6(Dec. 1968).

A procedure was developed for polarographic determination of aluminium in plutonium. The plutonium was separated by anion-exchange in a nitrate medium, and the aluminium was determined in the eluate by use of Superchrome Garnet Y. The aluminium concentration range in polarographed solutions was 0.020 to 0.800 μg/ml. The average recovery of aluminium was 99.3%, relative standard deviation 7.2%. Of 20 common impurities found in plutonium metal, only molybdenum and titanium caused significant interference; both can be removed by ion-exchange. (auth) (UK)

2253 COMPARISON OF QUANTITATIVE AND SUBSTOICHIOMETRIC DETERMINATION OF CAESIUM FROM FISSION PRODUCTS WITH NITROBENZENE SOLUTION OF LITHIUM DIPICRYLAMINATE. Krtil, J.; Bezdek, M. (Nuclear Research Inst., Rez, Czech.). Talanta, 15: 1423-33(Dec. 1968).

A method of determination of ^{137}Cs in a fission product mixture by extraction with a nitrobenzene solution of lithium dipicrylaminate is described. The effect of pH and the amount of reagent on the efficiency of extraction of micro-amounts of caesium was studied, as well as the competing effect of alkali metal salts; the possibility of substoichiometric determination of caesium was also investigated. Both procedures were tested with an artificial mixture of fission products. (auth) (UK)

2254 THE USE OF D-T-NEUTRONS FOR DETERMINATION OF GALLIUM IN ALUMINUM BY ACTIVATION ANALYSIS. Tustanovskii, V. T.; Orifkhodzhaev, U.; Starchik, L. P. Dokl. Akad. Nauk Tadzh. SSR, 11: No. 6, 20-2(1968). (In Russian).

Gallium was determined in an Al–Ga system by means of activation analysis using 14-MeV neutrons and d-t neutron reactions. Gamma radiation spectra taken with AN-100 analyzer connected to the γ-scintillation spectrometer with 90 × 70 mm NaI(Tl) crystal showed that the main analytical reaction of the gallium determination was the reaction $^{69}Ga(n,2n)^{68}Ga$ with $T_{1/2}$ = 68 min, E_γ = 0.51 MeV, and 1.07 MeV with interfering the reaction, $^{27}Al(n,p)^{27}Mg$, with the $T_{1/2}$ = 9.5 min, E_γ = 0.84 MeV and 1.01 MeV. The dominant reaction in the d-t neutron interaction with Ga nuclei was (n,2n) reaction. The cross sections of (n,2n) for ^{69}Ga and ^{67}Ga are 1.070 ± 10% and 2.180 ± 10%, respectively. The mean square error of the Ga determination according to 10 measurements of one specimen was 6%. (R.V.J.)

2255 XIII COLLOQUIUM SPECTROSCOPICUM INTERNATIONALE, OTTAWA, 1967. (Proceedings of the 13th International Conference on Spectroscopy, Ottawa, 19–23 June 1967. London, Adam Hilger Ltd., 1968. 478p. (CONF-670636).

One-hundred-forty-seven papers and the keynote address on spectral-analytical problems in astronomy are included. The subjects reported include: optical emission; ir absorption; astrophysics; flame and atomic absorption; information retrieval; geochemistry; macromolecules; uv absorption; x-ray fluorescence; and metals. (P.C.H.)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 2345, 2392, 2615, 2618, and 3593.

2256 (AEET-218) HYDRODYNAMIC MODEL OF SIMPLE ISOTOPIC EXCHANGE. Iyer, R. Krishnnamoorthy (Atomic Energy Establishment, Trombay (India). Analytical Div.). 1965. 9p. Dep.

A hydrodynamic model to demonstrate the principles of simple isotopic exchange is presented. The model consists of two cylindrical reservoirs filled with water to different levels and connected by a capillary tube. The difference in levels h decreases exponentially with time t: $h/h_0 = \bar{e}\ [k(a_1 + a_2)/a_1a_2]\ t$, where k is a constant for the same capillary tube h_0 = height at t = 0 and a_1a_2, refer to areas of cross section of reservoirs. This expression is parallel to the one derived for simple isotopic exchange: $1 - F = \bar{e}\ R[(A) + (B)/(A)(B)]\ t$, where F is the fraction exchanged, R the the rate constant of exchange and (A) and (B) the concentrations of the two chemical forms. (auth)

2257 (ANL-Trans-676) THE INVESTIGATION OF TRANSPLUTONIUM ELEMENTS: RESULTS, PROBLEMS, AND POSSIBILITIES. Mueller, W. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Element). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report EUR-3893. 59p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 27621.

2258 (ANL-Trans-678) SEVEN-VALENT STATE OF TRANSURANIUM ELEMENTS. PREPARATION AND IDENTIFICATION OF Np(VII) IN AQUEOUS SOLUTIONS AND IN THE SOLID STATE. Krot, N. N.; Mefod'eva, M. P.; Smirnova, T. V.;

Gel'man, I. A. D. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Radiokhimiya, 10: 412-18(1968). 10p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 50975.

2259 (COO-958-13) TECHNICAL PROGRESS REPORT [ON METAL-AMINE SOLUTIONS], SEPTEMBER 16, 1967-SEPTEMBER 15, 1968. Dye, James L. (Michigan State Univ., East Lansing). Contract AT(11-1)-958. 16p. Dep. CFSTI.

Developments are reported for studies on: metal-amine research; models for metal-ammonia solutions; optical spectra in metal-amine solutions; EPR studies of metal-amine solutions; kinetics of metal-amine reactions; and molecular-orbital calculations. (P.C.H.)

2260 (ZFK-124) EXPERIMENTAL PROBLEMS IN DETERMINATION OF THE SOLUBILITY OF URANIUM NITRIDE IN MOLTEN ALKALI METAL CHLORIDES. Daerr, Lothar; Naumann, Dieter (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). May 1967. 19p. (In German). Dep.

Investigations were made of the solubility of UN in NaCl, KCl, and NaCl-KCl eutectic at temperatures to 1000°C. For the NaCl-KCl melt at 850°C, 1.8×10^{-4} g U/g melt were found; for NaCl melt at 850°C the solubility was 1.3×10^{-8} g U/g melt. (M.C.G.)

2261 CRYSTAL STRUCTURE OF A TRIMERIC FORM OF TECHNETIUM OXIDE TETRAFLUORIDE. Edwards, A. I.; Jones, G. R.; Sills, R. J. C. (Univ. of Birmingham, Eng.). Chem. Commun., No. 19, 1177-8(1968).

It was found that small amounts of a green volatile solid were formed in the fluorination of Tc, which by crystal structure analysis was found to be a trimeric polymorph of $TcOF_4$. Crystallographic data were measured as $\underline{a} = 9.00 \pm 0.01$, $\underline{c} = 7.92 \pm 0.01$ Å (hexagonal), U = 556 Å^3, space group $P6_3/m$. The volume is consistent with Z = 6. Full-matrix least-squares refinement of positional and isotropic temperature parameters gave an R value of 0.108. The structure consists of trimeric units, with a distorted octahedral coordination of the Tc atoms and cis-bridging F atoms. A hexagonal form of molybdenum oxide tetrafluoride was also obtained, which was almost isodimensional with the Tc compound. (UK)

2262 CRYSTAL STRUCTURE OF HYDROXYTRICARBAMIDE URANYL POLYIODIDE $[UO_2(OH).3CO(NH_2)_2]I_4$. Mikhailov, Yu. N.; Kuznetsov, V. G.; Kovaleva, E. S. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Strukt. Khim., 9: 710-12(July-Aug. 1968). (In Russian).

The crystal structure of a compound with a composition of $UO_2(OH) \cdot 3.2\ CO(NH_2)_2 \cdot I^- \cdot 0.73\ I^0$ (with 33.45% U, 17.92% I^-, 13.12% I^0, and 13.01% N) was investigated. The synthesized crystals are stable in air. Tabulated data are given on the coordinates and isotropic temperature coefficients for all atoms in general position H(e) for hydroxytricarbomideuranyl polyiodide. (R.V.J.)

2263 HYDROGEN ISOTOPIC EXCHANGE BETWEEN GLYCERALDEHYDE-3-PHOSPHATE DEHYDROGENASE AND HEAVY WATER. Abaturov, L. V.; Zavodskii, P.; Varshavskii, Ya. M. (Inst. of Molecular Biology, Moscow). Mol. Biol. (Moscow), 2: 136-47(Mar.-Apr. 1968). (In Russian).

Kinetics of H-D exchange between peptide NH groups of glyceraldehyde-3-phosphate dehydrogenase (GAPD) and D_2O over a broad pH range was studied. Kinetics of H-D exchange in protamine sulfate was measured for comparison and the effect of sodium dodecylsulfate (SDS) on the kinetics of H-D exchange was followed. The rate of H-D exchange was characterized by a decrease in intensity of the amide II band in the ir spectrum. In the range of pH between 9.2 and 5.3 the fraction of slowly exchanged H atoms in GAPD gradually increased with decreasing pH. At extreme pH values (4.4 to 9.2) the rate of exchange increased sharply. In protamine sulfate the exchange rate at pH > 5 was found to be very fast so that it could not be measured. Like GAPD, it decreased gradually when the pH of the solution was decreased. The rate of H-D exchange in GAPD increased after addition of SDS. The interpretation of the experiments is based on the H-D exchange mechanism proposed by Hvidt (Compt. Rend. Trav. Lab. Carlsberg, 34: 299(1964)), according to which the protein molecules are considered to be a dynamically equilibrated population with varying degree of availability of peptide NH groups and with high conformational mobility. Analysis of the kinetics of H-D exchange vs pH suggests that the rate of conformational transitions in the enzyme studied exceeds that of H-D exchange in NH groups completely available for D_2O molecules in solution. (BBB)

2264 A PROCESS FOR THE COMPRESSION OF HEAVY HYDROGEN ISOTOPES. Vit, Jaroslav; Prochazka, Vladimir; Manula, Milan; Matys, Vlastimil (to Ceskoslovenska Akademie Ved). British Patent 1,132,872. Nov. 6, 1968. Filed Jan. 31, 1966, Czechoslovakia.

A process is described for the compression of heavy hydrogen isotopes. The quantity of deuterium or tritium is increased in a closed pressure vessel by reacting liquid D_2O or T_2O with a substance capable of reacting irreversibly therewith to evolve hydrogen isotopes. Examples of the process are given. (M.C.G.)

2265 THE ENZYMATIC AND NONENZYMATIC HYDROLYSIS REACTIONS OF S-ARYL PHOSPHOROTHIOATES. Milstien, Sheldon. Los Angeles, Univ. of California, 1968. 125p.

Thesis.

A synthetic method was developed for the synthesis of S-aryl phosphorothioates from the corresponding benzenesulfenyl chlorides and dibenzyl phosphite. The rates of hydrolysis of 4-methoxy, 4-methyl, 4-nitro, 2-isopropyl, and unsubstituted S-phenyl phosphorothioate were measured in water at 35°C as a function of pH. The typical rate maximum for the monoanionic species was found for all of the compounds at pH 3 to 4 except the p-NO_2. No rate maximum for the monoanion was found for S-(4-nitrophenyl) phosphorothioate, the dianion rate being 16.2 times more rapid than the monoanion rate. The monoanion rates are nearly insensitive to electronic effects. Deuterium oxide has little effect on the rates of the dianion reactions, but for monoanion hydrolysis, k_{H_2O}/k_{D_2O} varies from 1.78 for p-NO_2 to 1.4 for S-phenyl phosphorothioate. These values may indicate that the mechanism for monoanion hydrolysis involves a partially rate determining proton transfer step. The values of ΔS^* for hydrolysis of the neutral and monoanion species of S-(4-nitrophenyl) phosphorothioate are −1.9 eu and +7.9 eu, consistent with unimolecular decomposition to metaphosphate ion for both species. Acid catalysis is not observed with any of the compounds, the rates being nearly invariant at concentrations of HCl from 1.0 to 6.12 M. Electron withdrawal in the leaving group only facilitates the hydrolysis of the neutral species to a small extent. The solvent isotope effect for the neutral species is 1.83 and ΔS^* is −13.2 eu. Thus, the mechanism of neutral species hydrolysis probably involves nucleophilic attack by water in concert with a proton transfer step. The rates of hydrolysis of S-(2- and 4-carboxyphenyl) phosphorothioates were measured in H_2O and in D_2O as a function of pH or pD at 35°C. The pH-rate profiles for both compounds have maxima close to pH 4. The ortho-carboxyl substituted derivative hydrolysis 5.0 times faster than the para at the rate maximum and 6.3 times faster in 5.90 M HCl. On the basis of pK_a of the leaving group, the o-carboxy compound shows a rate enhancement of 18 times in 5.90 M HCl and approximately 5 times when compared at its pH-rate maximum to the other monoanions. The value of k_{H_2O}/k_{D_2O} for the neutral species of S-(2-carboxyphenyl) phosphorothioate is 1.7. Thus, the ortho-carboxyl group is participating in the reactions of the neutral and monoanion species with the most likely mechanism involving partially rate determining protonation of S by the unionized carboxyl group. The D_2O solvent isotope effect for the dianionic species is near unity, consistent with either pre-equilibrium protonation of S or nucleophilic catalysis by the carboxylate anion. The presence of an acyl phosphate intermediate, which would be formed by nucleophilic attack, could not be demonstrated. S-aryl phosphorothioates are good substrates for E. coli alkaline phosphatase. The enzymatic hydrolysis of a series of para-substituted phenyl phosphates and the corresponding phosphorothioates was studied to gain insight into the possible biological roles of thiophosphates and the mechanism of action of alkaline phosphatase. A simplified kinetic scheme has been used to determine the Michaelis constants and maximum velocities as a function of pH, overcoming the difficulties of strong product inhibition and high turnover of the enzyme. S-aryl phosphorothioates are hydrolyzed at a greater overall rate than the oxygen esters due solely to more favorable K_m values. The V_{max} values are essentially the same for both series of compounds indicating a common rate determining step. There is a tendency for K_m to become more favorable with increasing electron withdrawal in the leaving group. (Diss. Abstr.)

2266 LANTHANIDE COMPLEXATION REACTIONS. Silber, Herbert Bruce. Davis, Calif., Univ. of California, 1967. 178p.

Thesis.

The kinetics of lanthanide ion complexation with o-aminobenzoic acid (anthranilic acid) in aqueous sodium perchlorate were studied using the temperature-jump relaxation technique. Second-order rate constants corresponding to the reaction between the aquated rare earth ion and the o-aminobenzoate ion and the first-order rate constants for the reverse process were determined. Activation parameters were obtained. Corresponding experiments were carried out in D_2O and pertinent activation parameters were determined. Differences in the bimolecular rate constants and activation parameters in H_2O and the comparison of these values with corre-

sponding values obtained in D_2O gave information concerning both the structure of the aquated rare earth ion and the mechanism for the complexation reaction. A hydrogen-bonding model is proposed for the aquated lanthanide(III) systems. It is consistent with the experimental results. The data are consistent with a coordination number change occurring within the lanthanide(III) series for the aquated cations. (Diss. Abstr.)

2267 KINETIC HYDROGEN ISOTOPE EFFECTS IN THE PIPERIDINO DEHALOGENATION OF HETEROAROMATIC SUBSTRATES. Giardi, I.; Illuminati, G.; Sleiter, G. (Univ., Rome). Tetrahedron Lett., No. 53, 5505-8(Nov. 1968).

It is stated that hydrogen isotope effects in aromatic substitution reactions with primary and secondary amines as nucleophilic reagents have received little attention and no study has hitherto been reported dealing with N-heteroaromatic substrates. Therefore, the kinetic hydrogen isotope effects on the dehalogenation of some simple 2- and 4-fluoro- and chloro-quinoline derivatives in neat piperidine or N-deuteriopiperidine as solvent were examined. The data are tabulated. The isotope effects, as expressed by k_H/k_D ratios, were found to be absent or negligible if the leaving group was Cl, at either the α or γ position; they were small and positive if the leaving group was F at the γ-position, and negligible for F at the α-position. The results were similar to those found with nitro-activated systems, but showed some new features, which are relevant to the reaction mechanism; these features are discussed. (UK)

2268 SECONDARY DEUTERIUM KINETIC ISOTOPE EFFECTS ON THE THERMOLYSIS OF 1-PYRAZOLINES. Al-Sader, Basil H.; Crawford, Robert J. (Univ. of Alberta, Edmonton). Can. J. Chem., 46: 3301-4(Nov. 1, 1968).

Secondary kinetic isotope effects on four deuterated 1-pyrazolines support the formation of a trimethylene intermediate during gas phase thermolysis. Calculation of cyclization relative rate constants for the trimethylene intermediates reveals that substitution of hydrogen by deuterium has no effect when the terminal methylenes are substituted, but the rate constants are decreased when the central methylene's hydrogens are substituted. Explanations are advanced for all of the observed effects. (auth) (Canada)

2269 COMPOUND FORMATION IN THE SYSTEMS RARE-EARTH OXIDES–TELLURIUM DIOXIDE. Redman, M. J.; Binnie, W. P.; Carter, J. R. (Kennecott Copper Corp., Lexington, Mass.). J. Less-Common Metals, 16: 407-13(1968).

The rare earth (R.E.) compounds $(R.E.)_2Te_4O_{11}$ and $(R.E.)_2Te_3O_9$ were shown to exist in the systems rare earth oxides–tellurium dioxide. Also $Dy_4Te_3O_{12}$ was prepared and shown to have cubic symmetry. These compounds were prepared by solid-state reactions between the oxides, and by precipitation from aqueous solution. In addition, the compounds $(R.E.)_2Te_4O_{11}$ were obtained as single crystals from tellurium dioxide-rich melts. Space group and lattice parameters of these latter compounds were obtained from x-ray single crystal and powder work. (auth)

2270 THE CHLORIDE CATALYSIS OF THE Np(III)–Fe(III) REACTION IN AQUEOUS ACID SOLUTIONS. Newton, T. W.; McCrary, Gloria E.; Clark, W. G. (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 72: 4333-6(Nov. 1968).

The effects of chloride on the slower Np(III)–Fe(III) reactions have been found to be due primarily to the term $k(Np^{3+})(FeCl^{2+})$ with a small contribution from $k'(Np^{3+})(Fe^{3+})(Cl^-)$. Related, preliminary experiments have shown that the oxidations of Fe(II) by Ce(IV), V(V), and Np(VI) in the presence of Cl^- produce $FeCl^{2+}$ in greater than equilibrium concentrations. (P.C.H.)

2271 FLUORINATION OF NEPTUNIUM(IV) FLUORIDE AND NEPTUNIUM(IV) OXIDE. Trevorrow, L. E.; Gerding, T. J.; Steindler, M. J. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 30: 2671-7(Oct. 1968).

Rates of formation of NpF_6 by reactions at 250 to 400°C of NpF_4 with fluorine, with BrF_3, and with BrF_5 can be represented by a rate law that assumes the reaction site to be a continuously diminishing spherical interface. The rates of reaction of NpF_4 at 350°C lie in the order fluorine (100 mole %) > BrF_3(6 to 13 mole % in nitrogen) > BrF_5(33 to 35 mole %). Correlation of the derived rate constants by the Arrhenius equation yielded activation energies of 20 kcal/mole for the reaction of NpF_4 with fluorine and 26 kcal/mole for the reaction of NpF_4 with BrF_5. The solid residues from the reactions of NpF_4 with either BrF_5 or fluorine contained no species other than NpF_4. The fluorination of NpO_2 by either BrF_5 or fluorine proceeds through the intermediate compound NpF_4. Thus, the fluorination of NpO_2 is analogous to that of PuO_2, which proceeds through the intermediate compound PuF_4, but differs from the fluorination of UO_2, which proceeds through the intermediate compound UO_2F_2. (auth) (UK)

2272 REACTIONS OF URANIUM MONONITRIDE, THORIUM MONOCARBIDE, AND URANIUM MONOCARBIDE WITH NITRIC ACID AND OTHER AQUEOUS REAGENTS. Ferris, Leslie M. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem., 30: 2661-9(Oct. 1968). (ORNL-P-3505).

Uranium mononitride was inert at 80°C in water, 3 to 12M HCl, 1M H_2SO_4, 1M NaOH, 1M $NaNO_3$, and 5M NH_4NO_3; it did react in 1 to 2.5M $Al(NO_3)_3$. The nitride reacted with 0.5 to 15.8M HNO_3 to give gaseous mixtures of N_2, N_2O, NO, and NO_2 (NO_2 was produced only when the acid concentration was 6M or higher). In reactions of thorium monocarbide with 0.1 to 1M HNO_3 at 90°C, both hydrolysis (yielding mainly methane) and oxidation (yielding CO_2, N_2, and nitrogen oxides) of the carbide took place; at higher HNO_3 concentrations, only oxidation occurred. The principal reaction of UC or ThC with 4 and 6M NH_4F at 80°C was: (U or Th)$C_{(s)}$ + $5NH_4F_{(aq.)}$ → (U or Th)$F_4 \cdot NH_4F_{(s)}$ + 4 $NH_{3(g)}$ + $CH_{4(g)}$. (auth) (UK)

2273 KINETICS OF IODINE EXCHANGE BETWEEN ZINC IODIDE AND n-PROPYL AND n-BUTYL IODIDE IN ACETONITRILE. Howell, Barbara F. (Kansas State Teachers Coll., Emporia); Troutner, David E. J. Org. Chem., 33: 4146-9(Nov. 1968).

The exchange of iodine between zinc iodide and n-propyl iodide and between zinc iodide and n-butyl iodide has been studied in the temperature range 40 to 59° and in the zinc iodide concentration range 5×10^{-4} to 10^{-2} M. This exchange has been found to be first order with respect to n-propyl iodide or n-butyl iodide and zero order with respect to zinc iodide. The values of the Arrhenius parameters, E_a and log A, for n-propyl iodide are 22.6 ± 0.2 kcal/mole and 11.9 ± 0.3 (A in sec^{-1}), respectively, and for n-butyl iodide these values are 19.4 ± 0.8 and 9.6 ± 0.2. (auth)

2274 H_2O–D_2O ISOTOPE EFFECT IN PARTIAL MOLAL VOLUMES OF ALKALI METAL AND TETRAALKYLAMMONIUM SALTS. Conway, B. E.; Laliberte, L. H. (Univ. of Ottawa). J. Phys. Chem., 72: 4317-20(Nov. 1968).

The partial molal volumes of NaF, NaCl, NaBr, and tetraalkylammonium bromides were measured in H_2O and D_2O to determine the isotope effects. The apparent molal volumes of the salts were determined from densities. The results showed that a significant isotope effect, $\Delta V_{D_2O-H_2O}$, is measurable and in fact reaches appreciable values for compounds such as NaF at one end of the scale and $(n\text{-}Bu)_4NBr$ at the other. Of particular interest is the observation of a positive isotope effect (i.e., $\bar{V}_2O_{D_2O} > \bar{V}_2O_{H_2O}$) for structure-enhancing ions and a negative effect for what are commonly regarded as the structure-breaking ions. It was concluded that the results support the suggestion that a useful indication of whether or not ionic organic solutes cause structure-enhancing effects in water can be given by the sign and magnitude of the solvent isotope effect in the partial molal volumes. (P.C.H.)

2275 DEUTERON SPIN-LATTICE RELAXATION OF D_2O IN ORGANIC SOLVENTS. Hindman, J. C.; Svirmickas, A.; Wood, M. (Argonne National Lab., Ill.). J. Phys. Chem., 72: 4188-93(Nov. 1968).

Radiofrequency pulse techniques were used to measure the deuteron spin lattice-relaxation time for D_2O in certain organic solvents. In particular, solutions were examined where infrared observations indicate that the properties of the dissolved water molecules are only slightly altered from the gas state and where there is little evidence for strong intermolecular complex formation. Concentration dependence studies were used to derive the relaxation times for infinite dilution of D_2O in the organic solvent. The T_1 values were combined with deuteron quadrupole coupling constants calculated from infrared data to give values for the molecular reorientational correlation times, τ_O. As expected, these correlation times are much shorter than reorientational correlation times calculated from the Debye–Bloembergen–Purcell–Pound equations. The implications of these observations were considered with respect to models of water structure where the existence of freely rotating monomers is assumed. (auth)

2276 AMIDES AS LIGANDS. X. COMPLEXES OF γ BUTYROLACTAM WITH LANTHANIDE NITRATES. Miller, Warren V.; Madan, Stanley K. (State Univ. of New York, Binghamton). J. Inorg. Nucl. Chem., 30: 2785-93(Oct. 1968).

The syntheses and physical properties of the crystalline compounds $[Ln(BuL)_3](NO_3)_3$ (Ln = La, Nd, Gd), and $[Ln(BuL)_3(NO_3)_3]$ (Ln = Dy, Er, Yb) are reported. Infrared spectra of these complexes indicate that in the solid state the La, Nd, and Gd complexes contain ionic nitrate, while the Dy, Er, and Yb complexes contain covalent nitrato groups. Both molecular weight and conductance data indicate that the complexes containing ionic nitrate dissociate in solution. Both analyses and spectral studies indicate that the larger lanthanide ions have coordination numbers of eight, while the smaller lanthanides are seven-coordinated. (auth) (UK)

2277 ^{13}C ISOTOPE EFFECTS IN THE DECARBOXYLATION OF THE PYRIDINE CARBOXYLIC ACIDS. Zielinski, Mieczyslaw (Univ. of Warsaw). Trans. Amer. Nucl. Soc., 11: 473-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2278 ON THE SLOPE OF FREE ENERGY PLOTS IN CHEMICAL KINETICS. Cohen, Audrey O.; Marcus, R. A. (Univ. of Illinois, Urbana). J. Phys. Chem., 72: 4249-56(Nov. 1968).

In current electron-transfer theory, an activation free energy term, ΔF^*, depends in a simple way on the "standard" free energy of reaction, $\Delta F^{0\prime}$, in the prevailing medium. Namely, $\Delta F^* = \frac{1}{4}\lambda [1 + (\Delta F^{0\prime}/\lambda)]^2$, apart from small work terms; $\lambda/4$ is ΔF^*_0, the value of ΔF^* at $\Delta F^{0\prime} = 0$; and λ obeys a simple additivity property. As an exploratory step an equation of the same functional form was applied to data on Brønsted slopes of 16 proton- and atom-transfer reaction series. Thereby, the instantaneous slope of a ΔF^* vs $\Delta F^{0\prime}$ plot is calculated to be $\frac{1}{2} [1 + (\Delta F^{0\prime}/4\Delta F^*_0)]$. Thus far the experimental results are consistent with this equation, but more data are needed. Other applications of the ΔF^* equation including one to the kinetic isotope effect, are also discussed. A rather approximate derivation of the above equation for atom and other transfers was given previously. (auth)

2279 ISOMORPHISM OF THE ACETATES OF THORIUM AND OF URANIUM(IV). Bressat, Rene; Claudel, Bernard; Giorgio, Gerard; Mentzen, Bernard (Institut National des Sciences Appliquees, Lyon). J. Chim. Phys., 65: 1615-17(Sept. 1968). (In French).

The isomorphism of thorium and uranium(IV) tetraacetates is checked with precision and the crystallographic data of each salt are given. (auth)

2280 SYNTHESIS AND PROPERTIES OF DIFLUORODITHIOPHOSPHORIC ACIDS, HPS_2F_2 AND DPS_2F_2. Mitchell, Ronald W.; Lustig, Max; Hartman, Frederick A.; Ruff, John K.; Merritt, James A. (Army Missile Command, Redstone Arsenal, Ala. Rohm and Haas Co., Huntsville, Ala.). J. Amer. Chem. Soc., 90: 6329-32(Nov. 6, 1968).

The difluorodithiophosphoric acids HPS_2F_2 and DPS_2F_2 were prepared. Their physical properties, including a vibrational analysis, are reported. Evidence suggests that these new acids exist as hydrogen-bonded species. (auth)

2281 A POSSIBLE THEORETICAL EXPLANATION OF THE SHIFT OF THE CURIE TEMPERATURE IN KH_2PO_4 AND KD_2PO_4 UPON A HYDROSTATIC PRESSURE. Novakovic, L. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Phys. Chem. Solids, 29: 963-6(June 1968).

The effect of hydrostatic pressure on the Curie temperature of KH_2PO_4 and KD_2PO_4 was measured by Umebayashi et al. (Solid State Commun. 5, 591(1967)). Using the method of neutron diffraction and measuring the transition point T_c as a function of pressure up to 2 kbar it was found that the coefficient dT_c/dP is considerably different in the two crystals, $dT_c/dP = -4.52 \pm 0.06°$/bar for KH_2PO_4 and $-2.63 \pm 0.05°$/kbar for KD_2PO_4. It is demonstrated that this observation is consistent not only qualitatively but also numerically with a model in which the protons (or deuterons) tunnel quantum-mechanically through a certain potential barrier. (auth) (UK)

2282 RULE OF THE GEOMETRIC MEAN: ITS ROLE IN THE TREATMENT OF THERMODYNAMIC AND KINETIC DEUTERIUM SOLVENT ISOTOPE EFFECTS. Gold, V. (Brookhaven National Lab., Upton, N. Y.). Trans. Faraday Soc., 64: 2770-9(Oct. 1968).

The results of calculations are presented for the deuterium fractionation between a monohydric solute and water, as a function of the atom fraction n of deuterium in the solvent, and on the assumption of a range of values for the equilibrium constant K of the reaction $H_2O + D_2O \rightleftharpoons 2HOD$. Measurements of the deuterium fractionation between the hydroxylic hydrogen in tert-butyl alcohol and water by NMR are reported and are consistent with a value of K around 3.8. Similar calculations were performed for deuterium fractionation between the H_3O group of the hydrogen ion and water, with explicit consideration of the disproportionation equilibria for H_2DO and HD_2O groups. The treatment is extended to the consideration of the dependence on n of the acid dissociation constants of monobasic acids. The most plausible set of assumptions about the disproportionation equilibria of HOD, H_2DO, and HD_2O leads to results differing less from values calculated entirely on the basis of the rule of the geometric mean than those obtained using the best value for the HOD disproportionation but assuming the rule of the geometric mean to apply to the isotopically mixed hydrogen ions. (auth) (UK)

2283 A STUDY OF SOME NEW ABSORPTION BANDS OF SrH AND SrD IN THE ULTRA-VIOLET REGION. Khan, M. Aslam; Butt, M. R. (Univ. of Karachi, Pakistan). J. Phys., B (London), 1: 745-50(July 1968).

The absorption spectra of the SrH and SrD radicals were obtained in a King furnace. Six new bands of SrH at 3031 Å, 2914 Å, 2836 Å, 2680 Å, 2620 Å, and 2420 Å and two new bands of SrD at 3023 Å and 2917 Å were observed. Of these the SrH bands at 3031 Å and 2914 Å were analysed as the (0,1) and the (1,1) bands of the $F^2\Sigma \rightarrow X^2\Sigma$ system (at 2927 Å) and the SrD bands at 3023 Å and 2917 Å were shown to be the (1,0) and the (1,1) bands of the systems $G^2\Sigma \rightarrow X^2\Sigma$ (at 3115 Å) and $F^2\Sigma \rightarrow X^2\Sigma$ (at 2928 Å), respectively. The SrH band at 2420 Å was established as a new transition which may be called $H^2\Sigma \rightarrow X^2\Sigma$. The SrH bands at 2836 Å, 2680 Å, and 2620 Å, however, could not be classified because of lack of sufficient data. (auth) (UK)

2284 NITROUS OXIDE/NITROGEN ISOTOPE EXCHANGE ON TUNGSTEN. Gasser, R. P. H.; King, M. F.; Vaight, P. R. (Oxford Univ.). Trans. Faraday Soc., 64: 2852-5(Oct. 1968).

At room temperature the absence of $^{29}N_2$ when N_2O reacted with a $^{30}N_2$-saturated tungsten filament implies that only the nitrogen/oxygen bond was broken during the reaction. The catalysis of the nitrogen isotope exchange reaction $^{28}N_2 + {}^{30}N_2 = 2\,{}^{29}N_2$ by tungsten was completely inhibited at filament temperatures below 1600°K by the presence of N_2O. Above this temperature the efficiency of catalysis rose rapidly and reached its normal value at about 1800°K. (auth)

2285 PREPARATION AND CRYSTAL STRUCTURE OF CALIFORNIUM OXYFLUORIDE, CfOF. Peterson, J. R.; Burns, John H. (Univ. of California, Berkeley. Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem., 30: 2955-8(Nov. 1968).

A single crystal of CfOF was prepared by hydrolysis of CfF_3 at high temperature. It was identified by comparison of x-ray diffraction data with those of lanthanide and other actinide oxyfluorides. The crystal structure was determined by single-crystal x-ray diffraction techniques, and the parameters were refined by the method of least squares. The observed fcc structure is of the fluorite type, with oxygen and fluorine atoms randomly distributed over the anion sites. The unit cell dimension is 5.561 Å (σ = 0.004 Å), from which the Cf-(O, F) distance was calculated to lie between that predicted for the Sm-(O, F) and Eu-(O, F) distances in SmOF and EuOF. Isotropic thermal parameters, 2.6 $Å^2$ for Cf and 3.4 $Å^2$ for the average (O, F) anion, were obtained. (auth) (UK)

2286 POLYMORPHISM OF MOLYBDENUM SILICIDE. Svechnikov, V. N.; Kocherzhinskii, Yu. A.; Yupko, L. M. (Inst. of Metal Physics, Moscow). Dokl. Akad. Nauk SSSR, 182: 1313-14(Oct. 21, 1968). (In Russian).

A differential thermal analysis was made of the transformations taking place in alloys enriched with Mo at 1850°C and in alloys enriched with silicon at 1900°C. A thermogram is given of an alloy with 66 at. % Si and 44% Mo annealed for 110 hr at 1760°C. The effects of transformations in the solid state at 1850°C, at 1900°C (eutectics of $MoSi_2 + Mo_5Si_3$), liquidus at 2000°C, and transformation (in beryllium oxide of the crucible material) at 2045°C were analyzed. It is shown that the low-temperature modification, $MoSi_2$, has tetragonal lattice with parameters a = 3.202 ± 0.005 Å, c = 7.843 ± 0.005 Å, c/a = 2.449. The high-temperature modification has hexagonal lattice with parameters a = 4.642 ± 0.005 Å, c = 6.529 ± 0.005 Å, and c/a = 1.406. (R.V.J.)

2287 TEMPERATURE DEPENDENCE OF SENSITIZED FLUORESCENCE IN NAPHTHALENE CRYSTALS. Hammer, A.; Wolf, H. C. (Technische Hochschule, Stuttgart). Mol. Cryst., 4: 191-3(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The temperature dependence of sensitized fluorescence in naphthalene crystals was studied in order to determine whether the hopping model or the band model should be used to describe energy transfer in crystals like naphthalene. (B.G.D.)

2288 CHARGE-TRANSFER EXCITON STATE, IONIC ENERGY LEVELS, AND DELAYED FLUORESCENCE IN ANTHRACENE. Pope, Martin (New York Univ., N. Y.). Mol. Cryst., 4: 183-90(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

A study of the delayed electroluminescence of anthracene crystal has shown that the recombination of holes and electrons produces the normal fluorescence of anthracene, and that the time dependence of the fluorescence can be modified by an external

electric field. It is also shown that the recombination of holes and electrons produces what appears to be an ion-pair or charge-transfer (CT) exciton, that this CT exciton diffuses through the anthracene crystal, and can form a dimer with another CT-exciton; the decay of the dimer produces one photon, at most. The normal decay of the nearest neighbor CT exciton, and the CT-exciton dimer produces a tail that extends into the microsecond region. Some estimates are given for the lifetime of the CT exciton; ionic energy levels for anthracene crystal are also given. (auth)

2289 PATHWAYS OF TRIPLET–TRIPLET ANNIHILATION IN ETHANOLIC SOLUTIONS OF PYRENE. Stevens, B.; Ban, M. I. (Univ. of Sheffield, Eng.). Mol. Cryst., 4: 173-81(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The ratio of excimer to molecular fluorescence intensities in both the delayed and total emission spectra of pyrene in ethanol has been measured as a function of solute concentration and temperature from 150–350°K. An analysis of the data in terms of triplet-triplet annihilation leading directly to excimer formation (process 1) or production of the lowest excited molecular singlet state (process 2) shows that the relative probabilities k_1/k_2 of these processes increases from zero at low temperatures to a maximum of 1.8 at higher temperatures. (auth)

2290 ON THE EXCITED CYCLOHEXANE MOLECULE AS A POSSIBLE EXCITATION DONOR IN LUMINESCENCE PROCESSES. Burton, Milton (Univ. of Notre Dame, Ind.). Mol. Cryst., 4: 61-6(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Kinetics of processes involving radiation protection, luminescence quenching in cyclohexane solutions, and absorption spectra and luminescence of aliphatic glasses are reviewed. It is concluded that energy transfer in a cyclohexane system cannot involve excitation transfer from single excited cyclohexane molecules. That is, extraordinarily large values for k_t and k_q (rate constants of transfer process and quenching) in cyclohexane imply that the process in cyclohexane cannot involve simple excitation transfer from an excited donor molecule to an acceptor, that the process involves a type of reaction in which charge transfer (or electron capture) probably occurs in an initial act requiring about 10^{-13} sec or less, and that the values of k_t and k_q have only formal significance and do not relate to an isolable (chemical) mechanism. The Laor–Weinreb results are explained in terms of charge transfer. The luminescence observed is the consequence of charge transfer from cyclohexane C to scintillator X in the following series of reactions: $C \rightarrow C^+ + e$; $C^+ + X \rightarrow C + X^+$; $X^+ + e \rightarrow X^*$; and $X^* \rightarrow X + h\nu$. (BBB)

2291 MIGRATION OF TRIPLET EXCITONS IN MOLTEN NAPHTHALENE. Baessler, H. (Technische Hochschule, Munich). Mol. Cryst., 4: 201-12(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Photoconductivity measurements were carried out with pure molten naphthalene. The material used was zone-refined 50 times Measurements were also performed on purified α- and β-methylnaphthalene, biphenyl, anthracene, and pyrene. Irradiation of the hydrocarbons in their liquid state with the full spectrum of the Xe arc beam produced a photocurrent similar to that found in α-methylnaphthalene irradiated through a transparent electrode with uv light. After a rise time varying between 0.02 and 0.3 sec it reached an equilibrium value and decreased within the same order of time after switching of the illumination. Irreversible increase of the conductivity was observed only if impurities were present, enabling radical formation with illumination. The rise time depends on the material (lower values for anthracene and pyrene) and on the size of the irradiated volume. The saturation value of the photocurrent generally increased linearly with photon intensity and slightly superlinearly with applied field. The spectral response curves of the photocurrent were all of the same type of curve, with 2 main peaks being obtained with all compounds investigated. The long-wave peak coincided with the wavelength of maximum absorption attributed to the forbidden singlet-triplet transition. The short-wave peak was at the singlet absorption edge. A model is proposed, based on the assumption that triplet excitons can migrate over large distances from the excitation region to the anode where they can produce charge carriers. Numerical calculations support the model. (BBB)

2292 DELAYED LUMINESCENCE OF ORGANIC MIXED CRYSTALS. IV. TRIPLET–TRIPLET ANNIHILATION PHENOMENA. Kinoshita, M.; McGlynn, S. P. (Louisiana State Univ., Baton Rouge). Mol. Cryst., 4: 231-51(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Triplet-triplet annihilation in the following mixed crystal systems was discussed: phenanthrene-h_{10} in biphenyl, phenanthrene-d_{10} in biphenyl, naphthalene-h_8 in biphenyl, naphthalene-d_8 in biphenyl, and chrysene in biphenyl. The kinetics of the phenomenon were elaborated, particular attention being paid to the effects of host-guest triplet energy gaps, random walk of triplet host excitons, and the influence of adventitious impurity or host crystalline defects. The topics discussed, and for which experimental information is presented, are: (1) the decay behavior of phosphorescence and delayed fluorescence; (2) the temperature dependence of the above decays; (3) the growth characteristics of phosphorescence and delayed fluorescence; (4) the temperature dependence of phosphorescence and delayed fluorescence intensities; (5) the concentration dependence of delayed fluorescence intensity; and (6) the incident intensity dependence of phosphorescence and delayed fluorescence intensities. It was shown that all data, with the single exception of delayed fluorescence decay at $T \sim 77°K$, are in accord with the kinetic model developed. The decay behavior of delayed fluorescence at 77°K was interpreted in terms of a crystal defect model. Exception was taken to the model of Hadley, Rast, and Keller for the temperature dependence of phosphorescence decay; the annihilative model is in better accord with fact. (BBB)

2293 QUANTUM EFFICIENCIES OF TRIPLET FORMATION IN AROMATIC MOLECULES. Windsor, M. W.; Dawson, W. R. (TRW Systems, Redondo Beach, Calif.). Mol. Cryst., 4: 253-8 (1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

A knowledge of the quantum yields of fluorescence, ϕ_F, and phosphorescence, ϕ_P, alone does not make it possible to separate the 2 nonradiative processes, $\phi_{F'}$ and $\phi_{P'}$, which quench respectively the first excited singlet state, S_1, and the lowest triplet state, T_1. To do this, the quantum yield of triplet formation, ϕ_T, must be known. Measurements were made of the extinction coefficients, ϵ_T, of triplet-triplet absorption for a series of aromatic hydrocarbons in EPA at 77°K. From the ϵ_T data plus chemical actinometry, values were obtained. In addition, accurate absolute measurements were made of fluorescence yield, ϕ_F, in solution at 25°C. From the present ϕ_F data and room-temperature values of ϕ_T reported by Lamola and Hammond, it was possible to calculate values of $\phi_{F'}$. Benzene, naphthalene, phenanthrene, crysene, and 1,2-benzanthracene had significant values of ϕ_F. Perdeuteration caused no significant change in the value of $\phi_{F'}$. It was concluded that internal conversion from S_1 and S_0 is determined largely by processes other than coupling of the electronic excitation to C-H vibrations. At 77°K, ϕ_F data to combine with the ϕ_T values were available only for anthracene. Depending on which of 2 ϕ_F values was used, the value obtained for $\phi_{F'}$ was either 0.20 or 0.12 with an uncertainty of ±0.10. (BBB)

2294 DEUTERIUM ISOTOPE EFFECTS ON THE LIFETIME OF THE PHOSPHORESCENT TRIPLET STATE OF NAPHTHALENE. Watts, Richard J.; Strickler, S. J. (Univ. of Colorado, Boulder). J. Chem. Phys., 49: 3867-71(Nov. 1, 1968).

The effect of the number and position of deuterium substituents on the phosphorescence lifetime was studied for eight different isotopic naphthalenes at 76°K. These studies reveal a significant dependence of the rate of radiationless decay to the ground state on the positions of the protons in the molecule. This conclusion is contrary to the conclusion of Lin and Bersohn that the radiationless decay is independent of the positions of the protons. It is found that protons in the α positions are about 1.6 times as effective as protons in the β positions in promoting radiationless transitions. A simple empirical relation is found to give a reasonable fit to the data. A small intermolecular isotope effect on the triplet-state lifetime of naphthalene-d_8 in ethanol is also found upon deuteration of the solvent. The experimental results are discussed in terms of existing theories of radiationless processes. (auth)

2295 CHELATES OF ACTINIDES(V) WITH AMINOACETIC ACID. Eberle, S. H.; Wede, U. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett., 4: 661-4(Nov. 1968). (In German).

Chelate equilibria between aminoacetic acid and Np(V) and Pu(V) were studied spectrophotometrically (for Np) and by ion exchange (for Pu). (UK)

2296 CHELATION OF URANYL IONS BY ADENINE NUCLEOTIDES. II. PROTON MAGNETIC RESONANCE INVESTIGATION OF THE URANYL NITRATE–ADENOSINE 5'-MONOPHOSPHATE CHELATE IN D_2O AT BASIC pD. Agarwal, Raghunath P.;

Feldman, Isaac (Univ. of Rochester, N. Y.). J. Amer. Chem. Soc., 90: 6635-9(Nov. 20, 1968). (UR-49-948).

Proton magnetic resonance spectra (100 MHz) of various mixtures of uranyl nitrate and adenosine 5′-monophosphate in D_2O at pD ~ 10 have been obtained and analyzed. In 0.1 M equimolar solution all 5′-AMP proton resonances experience a downfield shift, specifically, H_8 (0.46 ppM), H_2 (0.31 ppM), $H_{1'}$ (0.03 ppM), $H_{2'}$ (2.87 ppM), $H_{3'}$ (0.74 ppM), $H_{4'}$ (2.35 ppM), $H_{5'}$ (1.04 ppM), and $H_{5''}$ (0.32 ppM). The uranium-induced purine proton shifts are attributed to destacking of the adenine rings plus complete elimination of the specific phosphate deshielding of H_8. The movement of the ribose proton signals is believed to result from the formation of a dinuclear sandwich-type chelate in which one uranyl group is chelated by the 2′- and 3′-ribose oxygen atoms of one 5′-AMP molecule and by a phosphate oxygen and the 3′-oxygen of a second AMP molecule, and a second uranyl group is chelated by the 2′- and 3′-oxygens of the second AMP molecule and a phosphate oxygen and the 3′-oxygen of the first AMP. This chelate structure is so strong that the free ligand resonances and the complexed ligand resonances appear simultaneously in the spectrum of a mixture containing excess AMP, with no difference in their purine proton peak widths being detectable. The compatibility of the proposed structure and its PMR spectrum is discussed. (auth)

2297 ACID-CATALYZED HYDROLYSIS OF ACYL PHOSPHATES. Phillips, David R.; Fife, Thomas H. (Univ. of Southern California, Los Angeles). J. Amer. Chem. Soc., 90: 6803-9(Nov. 20, 1968).

The rates of acid-catalyzed hydrolysis of a series of aliphatic acyl phosphates with varying steric bulk in the acyl group have been measured in water at 25°. At constant ionic strength, plots of log k_{obsd} vs. log HCl concentration, with acid concentration increasing to 4.80 M, are linear with slopes deviating slightly from 1.0. At high ionic strength an abnormal order of reactivity was observed, the 3,3-dimethylbutyryl derivative hydrolyzing faster than the other compounds in the series. There was a large positive ionic strength effect with each compound and 3,3-dimethylbutyryl phosphate was affected to the greatest extent. The second-order rate constant for the acid-catalyzed reaction independent of ionic strength effects for 3,3-dimethylbutyryl phosphate was only slightly less than that for acetyl and much larger than that for trimethylacetyl phosphate. Plots of log ($k_{obsd} + H_0$) vs. log ($C_H + H_0$) have linear slopes of +0.31 for acetyl phosphate and −0.33 for 3,3-dimethylbutyryl phosphate, while trimethylacetyl phosphate yielded a curved line. Values of k_{D_2O}/k_{H_2O} was between 2.2 and 2.6 for all compounds. The ΔS^* for 3,3-dimethylbutyryl phosphate (+0.6 eu) was more positive than that for acetyl phosphate (−5.1 eu) or trimethylacetyl phosphate (−9.7 eu). Cleavage of the C−O bond was demonstrated for the 3,3-dimethylbutyryl derivative. The rate constants for acid-catalyzed hydrolysis of substituted benzoyl phosphates in 25% dioxane−H_2O at 25° showed only a small sensitivity to electronic effects ($\rho = -0.24$) indicating an A2 mechanism for acyl phosphate hydrolysis. Thus with the aliphatic acyl phosphates, there are very likely differences in the importance of bond breaking in the transition state or differences in ground-state and transition-state hydration. (auth)

2298 DEUTERIUM ISOTOPE EFFECTS IN THE DECOMPOSITION OF ORGANOMETALS BY PROTON DONORS. Pocker, Y.; Exner, J. H. (Univ. of Washington, Seattle). J. Amer. Chem. Soc., 90: 6764-73(Nov. 20, 1968).

Deuterium isotope effects associated with proton vs deuteron transfer reactions from oxygen and carbon acids to the phenyl and benzyl derivatives of magnesium, lithium, and sodium in diethyl ether and in tetrahydrofuran (THF) have been determined by a competitive method. The isotope effects, k_H/k_D, observed with oxygen acids, phenol, water, methanol, and t-butyl alcohol are small, varying between 1.0 and 1.5, and suggest a reaction pathway involving the prior replacement of a metal-coordinated solvent molecule by the oxygen acid. On the other hand, proton transfers to organometals from the carbon acids, phenylacetylene, indene, fluorene, p-biphenylyldiphenylmethane, and triphenylmethane in THF are associated with isotope effects, k_H/k_D, which vary between 1.4 and 10.8. The isotope effects in the reactions of each organometal with the series of carbon acids support the theoretical prediction of a maximum isotope effect and provide information about the transition states for these proton transfer processes as well as about the nature of these organometallic compounds. (auth)

2299 CHEMISTRY OF LANTHANONS. XVIII. MIXED CHELATES OF La, Pr, Nd, Sm, AND Y CONTAINING β-DIKETONE AND BIS-SALICYLALDEHYDE ETHYLENEDIAMINE. Dutt, N. K.; Nag, K. (Indian Association for the Cultivation of Science, Calcutta). J. Inorg. Nucl. Chem., 30: 2779-83(Oct. 1968).

Mixed ligand complexes of lanthanides (La, Pr, Nd, Sm) and Y containing both β-diketone and bis-salicylaldehyde ethylenediamine (H_2 Salen) as the associated ligand molecules were prepared. By reacting tris-acetyl acetonate and tris-propionyl acetonates of the above lanthanides with the Schiff's base in ammoniacal atmosphere, compounds obtained were of the type $[Ln(diket)_2(Salen)_{0.5}]$, whereas by refluxing the tris-benzoyl acetonates and tris-dibenzoyl methanides with the Schiff's base a second series of compound [Ln(diket)(Salen)] was obtained. Sodium salts of tetrakisbenzoyl acetonates and dibenzoyl methanides also yielded compounds of the second type. (auth)

2300 ISOTOPE EFFECTS ON THE SUCCINATE DEHYDROGENASE-L-CHLOROSUCCINATE SYSTEM. Gawron, Oscar; Glaid III, Andrew J.; Mahajan, Kishan P.; Kananen, Gerald; Limetti, Marie (Duquesne Univ., Pittsburgh). J. Amer. Chem. Soc., 90: 6825-32(Nov. 20, 1968).

Relative rates, $rate_H/rate_D$, at pH 7.8, 30°, of succinate dehydrogenase, soluble and particulate-bound, catalyzed ferricyanide oxidation of several deuterated L-chlorosuccinates are, α-deuterio-, 1.1; β-erythro-deuterio-, 1.0; α,β-threo-dideuterio-, 2.1; β-threo-deuterio-, 2.0. A kinetic isotope effect is thereby established for breaking the β-threo-carbon-hydrogen bond of substrate and analysis of steady-state kinetic data obtained with normal substrate and α,β-threo-dideuterio-L-chlorosuccinate suggests that this isotope effect occurs at reduction of enzyme by substrate. Interpretation of steady-state data obtained with soluble enzyme was made on the basis of a previously proposed kinetic mechanism involving reoxidation of reduced enzyme before and after dissociation of product. Steady-state data obtained with particulate-bound enzyme require a mechanism involving reoxidation of reduced enzyme after dissociation of product and, in addition, competitive inhibition by ferricyanide. Experiments regarding application of an enol-hydride mechanism to the succinate dehydrogenase catalyzed oxidation of L-chlorosuccinate indicate little or no exchange prior to oxidation. (auth)

2301 OXYGEN ISOTOPE EFFECTS BY A NON-COMPETITIVE TECHNIQUE: THE TRANSITION-STATE CARBONYL STRETCHING FREQUENCY IN ESTER CLEAVAGE. Mitton, C. G.; Schowen, R. L. (Univ. of Kansas, Lawrence). Tetrahedron Lett., No. 55, 5803-6(Nov. 1968).

A study was made of the carbonyl-oxygen isotope effect for the methoxide catalysed methanolysis of aryl benzoates, determined by measurement of individual rate constants for the ^{16}O and ^{18}O carbonyl-labeled esters. Such effects are of the order of a few per cent in magnitude, and have hitherto been determined by competitive methods. Kinetics were determined by the usual spectrophotometric technique. Rate constants are tabulated for the p-bromophenyl benzoate compounds. A kinetic isotope effect of 1.018 ± 0.005 was found, and the carbonyl stretching vibration frequency was found to be 1300 ± 200 cm^{-1}. The value of k_{16}/k_{18} for phenyl benzoate was found to be 1.024 ± 0.013. Results are discussed. (UK)

2302 RESOLUTION OF COMPLEX SPECTRA. McKay, H. A. C.; Scargill, D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 30: 3095-8(Nov. 1968).

Isosbestic points are used in solution chemistry to provide evidence about the number of chemical species present in the solutions studied. If a series of spectra shows several isosbestic points it can usually be concluded that there are only two absorbing species, or three species of which two have identical spectra. This test, though simple, is open to the objection that it uses only a small part of the available information, viz. that referring to the wavelengths at the isosbestic points. It can also happen that there are no intersections in the spectra concerned, or that the intersections are at awkward angles which leave possible isosbestic points ill-defined. A more powerful test using the whole of the spectrum, but which is still very simple to apply, is described, and examples are given of the application to mixed solutions of Co and Ni, and to U(IV) in HNO_3-HClO_4 medium. (auth) (UK)

2303 MICROWAVE SPECTRUM, BARRIER TO INTERNAL ROTATION, STRUCTURAL INFORMATION, AND QUADRUPOLE COUPLING OF 1-CHLORO-1, 1-DIFLUOROETHANE. Graner, Georges; Thomas, Clarence (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 49: 4160-7(Nov. 1, 1968).

The microwave spectra of two isotopic species, $CH_3-CF_2\ ^{35}Cl$ and $CH_3-CF_2\ ^{37}Cl$, were investigated in the region 8 to 40 GHz. A partial determination of structure strongly suggests a shortening in C−C, C−F, and C−Cl distances compared to singly or doubly substituted fluoro- or chloroethanes. Vibrationally excited states were observed showing doublets due to the hindered internal rotation of the methyl group. An analysis of these doublets gives a barrier to internal rotation of 4400 ± 100 cal/mole. The chlorine quadrupole coupling tensor is nearly symmetric about the C−Cl bond. This implies a pitfall in the application of simple resonance

theory to molecules of this type; with simple resonance theory the shortened C–Cl bond is explained in terms of considerable double-bond character for the C–Cl bond, which in turn would call for an asymmetric χ tensor. (auth)

2304 TRI- AND TETRA-DENTATE OXALATE IONS: THE STRUCTURE OF THE DIURANYL TRIOXALATE ION. Alcock, N. W. (Univ. of Warwick, Coventry, Eng.). Chem. Commun., No. 21, 1327(1968).

Ammonium diuranyl trioxalate, $(NH_4)_2(UO_2)_2(C_2O_4)_3$, which shows unusual linking of the two uranyl groups, was found to be monoclinic, with a = 9.27, b = 13.55, c = 6.19Å, β = 87.5, Z = 4, space group $P2_1/n$. The bond lengths do not depart significantly from expected values, and the uranyl groups are joined into infinite double chains, running parallel to the c axis, by linking oxalate ions. In order to achieve five coordination for all the uranyl groups, the oxalate ions are tri- and tetra-dentate. The presence of multiple coordination explains the stability of this uranyl anion in solution as a multinuclear species, and its low solubility. The large chelating span of the oxalate ion has the effect of reducing the coordination of the uranyl group from the usual six to five, giving an almost symmetrical pentagonal bipyramid in which the O–O contacts between chelating groups are long enough to avoid steric repulsion. (UK)

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Refer also to abstracts 2238, 2255, 2361, 2519, 2527, 2529, 2956, and 3090.

2305 (BMwF-FBK-68-31) INVESTIGATION OF γ RADIOLYSIS OF POLYSTYRENE. Heusinger, H.; Wilske, J. (Technische Hochschule, Munich (West Germany). Institut fuer Radiochemia). July 1968. 34p. (In German). Dep.

For polystyrene samples, which contained pyrene in various concentrations, the G-values of radical formation, hydrogen production, and crosslinking were determined for γ-irradiation at room temperature. By addition of pyrene, the radical formation in polystyrene decreased rapidly, while hydrogen production and crosslinking were nearly unaffected. It could be shown that the formation of radicals, which can be detected by ESR spectroscopy after irradiation, starts from the first excited singlet state of polystyrene and competes with radiationless energy transfer to pyrene molecules. Hydrogen production and crosslinking are independent of the formation of these radicals and should be due to ion-molecule reactions or reactions of hot hydrogen atoms. The results indicate that in addition to energy transfer from polystyrene to pyrene by dipole-dipole interaction, intramolecular energy transfer within polystyrene molecules takes place, too. (auth)

2306 (NP-17657) RADIOLYSIS OF SOLID GLYCINE. de Bie, Marius Johannes Aart (Utrecht Rijksuniversiteit (Netherlands)). 1968. 85p. Dep.

Thesis.

The effects of ionizing radiation, particularly 50 kVp x rays and ^{60}Co gamma rays on polycrystalline glycine in the alpha-, beta-, and gamma-modifications and on polycrystalline trideuteroglycine were investigated. The electron spin resonance technique was used for free radical determinations in the solid material. In alpha- and beta-glycine the radicals $^+NH_3{\cdot}CHCO_2^-$ and $\cdot CH_2CO_2^-$ are present in practically equal amounts; in gamma-glycine only $^+NH_3{\cdot}CHCO_2^-$ is detected. Since the only radical in glycine-d_3 is $^+ND_3{\cdot}CHCO_2^-$, glycine-d_3 appears to be in the gamma-glycine crystal structure. The dose-effect curves for total free radical concentration are identical for all samples (G = 3.2). At doses larger than 5 Mrad a new radical, tentatively identified as $H{\cdot}C(-O-)CO_2$ and probably formed from $^+NH_3{\cdot}CHCO_2^-$, could be detected in both compounds and all crystal modifications. The yields of acetic acid and glyoxylic acid, extrapolated to zero dose, are equal and the same for alpha-, gamma- and trideutero-glycine (G_0 = 3.7). At high dose the yield of acetic acid is higher than the yield of glyoxylic acid; these yields are lowest for alpha-glycine. The yields of methylamine and carbon dioxide are equal and independent of the crystal structure and the irradiation dose (G = 0.28). The acetic acid, glyoxylic acid, methylamine, and glycine formed upon irradiation of glycine-d_3 are partially deuterated at the alpha-carbon atom. The results are explained on the basis of the radiolysis scheme of Platzman. It was concluded that radical reactions, particularly intermolecular hydrogen abstraction reactions, occur in a crystal lattice. The final outcome of such radical reactions is strongly dependent on the crystal structure and more particular on the mutual distances of the reaction partners. A complex system of hydrogen abstraction reactions and radical-radical annihilation reactions is responsible for the shape of the dose-effect curves. (auth)

2307 (NP-tr-1709) RECENT TRENDS IN RADIATION-INDUCED POLYMERIZATION, WITH PARTICULAR REFERENCE TO MECHANISMS. Tabata, Y. Translated by R. A. Scutt (Atomic Energy Research Establishment, Harwell, Eng.), from Genshiryoku Kogyo, 13: No. 8, 33-8(1967). 23p. Dep.

A review is presented on the present state of research, dealing mainly with the initiation nuclei, in radioinduced radical and ion polymerization in the liquid phase. In solid phase polymerization, discussion is concentrated on the mechanism of the low temperature reaction. (31 references). (P.C.H.)

2308 (NSJ-tr-127) PRODUCTS OF γ-RAY INDUCED TELOMERIZATION REACTION BETWEEN ALLYL ALCOHOL AND CARBON TETRACHLORIDE. Okubo, Masao. Translated from Nippon Kagaku Zasshi, 88: 212-15(1967). 12p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 15952.

2309 (NSJ-tr-130) RADIATION-INDUCED GRAFT COPOLYMERIZATION OF STYRENE TO POLYETHYLENE SINGLE CRYSTAL AGGREGATE FILM. RELATION BETWEEN POLYMER RADICAL AND GRAFTING EFFICIENCY. Takamatsu, Toshiaki; Kaibara, Makoto. Translated from Rika Gaku Kenkyusho Hokoku, 42: 231-7(1966). 15p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 4182.

2310 (NSJ-tr-133) RADIATION INDUCED TERPOLYMERIZATION OF SULFUR DIOXIDE, ACRYLONITRILES, AND OCTENE-1. Ito, Masayuki; Kuri, Zen-ichiro. Translated from Kogyo Kagaku Zasshi, 70: 1011-12(June 1967). 8p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 42987.

2311 (RFP-Trans-39) FORMATION MECHANISMS OF HYDROGEN PEROXIDE IN TITANIUM SULFATE–OXALIC ACID SYSTEM BY THE GAMMA-RAY IRRADIATION. Hasegawa, K. Translated for Rocky Flats Div., Dow Chemical Co., Golden, Colo., from Radioisotopes (Tokyo), 16: 428-33(Sept. 1967). 12p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 10303.

2312 (RRL-2310-251) QUARTERLY REPORT [ON RADIATION RESEARCH], JULY 1–SEPTEMBER 30, 1968. Fundamental Research No. 6041. (Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.). Oct. 8, 1968. Contract AT(30-1)-2310. 22p. Dep. CFSTI.

Research progress is reported on positive ion reactions in cyclohexane, effect of ion scavengers on atomic and molecular yields of hydrogen in radiolysis of hydrocarbons, electron scavenging by propyl bromides, hydrogen abstraction by perfluoroalkyl radicals, photolytic radical production in an SF_6 matrix, ESR studies of aqueous solutions during radiolysis, formation of radical anions in cyano and nitrobenzenes, radiation chemistry of aqueous solutions of NF_3, interaction of tricyanoanisole with methoxide ion, reactions of active nitrogen with nitrosyl chloride, flash photolytic studies of dichloride ion, photosensitized photolysis of cyclopropane, electron reactions in gases, and synthesis of ESR spectra. (M.C.G.)

2313 (VDDIT-93(Suppl.1)) RADIATION-INDUCED POLYMERIZATION ON CELLULOSE AND WOOD. A Literature Survey. Holm, Hans I. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Mar. 1966. 17p. Dep.

Thirty-seven references with abstracts to papers published during 1964 and 1965 are presented. (M.C.G.)

2314 PRIMARY PRODUCTS OF THE RADIOLYSIS OF WATER AND THEIR REACTIVITY. Pikaev, A. K.; Ershov, B. G. Russ. Chem. Rev. (Engl. Transl.), 36: 602-20(Aug. 1967).

Evidence for the mechanism of radiolysis of water is reviewed. The free-radical theory of the radiolysis of water is first outlined. Evidence for products such as the hydrated electron, the H atom, the OH radical, the HO_2 radical, the O atom, excited water, and the molecular products H_2 and H_2O_2 is detailed and criticized. Although water has a crystal structure with short-range order, excitons in it, if they are produced, have an extremely short lifetime, and in dilute aqueous solutions they break down (possibly to OH and e^-_{aq}) without being able to migrate. A multitude of theories regarding the ways in which the molecular products of the radiolysis of water H_2 and H_2O_2 are formed is reviewed. The problem of maximum yield in the decomposition of water is examined. The magnitude of $G(-H_2O)$ is determined by the ionization of the water, without allowance for the reactions H + OH and e^-_{aq} + OH in the spurs. The yield for the decomposition of water $G'(-H_2O)$ with allowance for spur reactions amounts to ~6. Diffusion-kinetic calculations show that the yield may reach ~8. In the gaseous phase in the presence

of cyclohexane or ammonia G(−H_2O) has the values 7.0 (over the range 125 to 250°C) and 10.6 (above 300°C). Data indicate that the maximum yield for the decomposition of water amounts to 12 to 14 molecules per 100 eV. The maximum yield due to ionization is 6 to 8 molecules per 100 eV. In dilute solutions these yields can be achieved only in exception instances, if at all. Data bearing on radiolysis of dissolved species are also reviewed. 472 references are listed. (BBB)

2315 RADIOLYSIS OF RAFFINOSE TYPE OLIGOSACCHARIDES IN SOLID STATE. I. IDENTIFICATION OF PRODUCTS. Maeda, Masaakira; Murakami, Susumu (Saitama Univ., Urawa, Japan). Sci. Rep. Saitama Univ., Ser. A, 6: 5-16(1968).

Studies showed that extensive radiolysis of solid oligosaccharides of raffinose type was effected by irradiation with different γ-ray doses from ^{60}Co. The minimal dosage required for the radiolysis was estimated to 510×10^4 R/hr for sucrose and raffinose, and 54×10^4 R/hr for stachyose, respectively. With sucrose, the degradation of crystalline structure was observed as the initial reaction followed by the cleavage of glycosidic bond. However, synthetic reaction leading to the formation of other oligosaccharides other than sucrose did not occur even with 6600×10^4 R/hr dosage. Radiolytic cleavage of the glycosidic bonds in raffinose was initiated by the liberation of D-fructose leaving melibiose which was further split into a mixture of D-galactose and D-glucose by irradiation with higher dosage. In addition, the formation of unknown oligosaccharides was also recognized as the reaction products. Although the mechanisms remained unknown, rebinding of activated sugar residues produced during radiolysis is a feasible explanation for synthetic reaction. The effects of irradiation on stachyose were rather characteristic. As the first step of radiolytic reaction, the terminal galactosyl residue was liberated which immediately combined with other sugar molecules yielding oligosaccharides higher than stachyose. Further with increase in dosage, the cleavage occurred at the glycosidic bond involving β-fructofuranosyl residue in a manner similar to the case of raffinose. (auth)

2316 METHOD OF GRAFT POLYMERIZATION. Tada, Shotaro (to Sumitomo Electric Industries, Ltd.). Japanese Patent 1968-14348. June 17, 1968. Filed May 12, 1964.

A method is described for graft polymerizing a compound onto a film material. The following advantages are cited: easy removal of homopolymer from the product; uniform grafting; easy graft-polymerization of a large film; and easy pressing, from outside, of the film when using a bag. A sheet into which the compound for grafting is infiltrated, and a film onto which it is graft-polymerized, are piled upon each other, and the whole is irradiated with ionizing radiation. The same pile as above is sealed in a flexible bag, and the whole is irradiated with ionizing radiation. (NSA of Japan)

2317 RADIOLYSIS OF LIQUID ETHANE SOLUTIONS. Bakale, George. Cleveland, Case Western Reserve Univ., 1968. 199p.

Thesis.

The γ radiolysis of liquid ethane and the effects of several reactive solutes were studied at −78°C by total analysis of the products. The extrapolated G-values of the major products formed by the radiolysis of pure C_2H_6 are $G(H_2) = 3.96$, $G(CH_4) = 0.39$, $G(C_2H_2) = 0.09$, $G(C_2H_4) = 0.74$, $G(C_3H_8) = 0.52$, and $G(C_4H_{10}) = 2.40$. Also, propylene, butenes, and C_5, C_6, C_7, and C_8 hydrocarbon products were observed. The hydrogen/carbon ratio of the measured products was 3.02. Dose effects on the product yields indicated that most thermal H atoms add to radiolytic C_2H_4 at doses greater than 5×10^{19} eV, but at lower doses, abstraction from C_2H_6 by thermal H atoms effectively competes with the addition reaction. From radiolysis of $C_2D_6-C_2H_6$ solutions it was concluded that a significant fraction of the hydrogen and methane yields result from hot H atom and hot methyl abstraction reactions, respectively. Isotope effects were observed in these reactions. Isotopic analysis of the radiolytic methane and propane indicated methylene precursors. Ratios of disproportionation/combination for methyl−ethyl and ethyl−ethyl reactions were found to be 0.15 and 0.31, respectively, from product analysis of $C_2D_4-C_2H_6$ radiolyses. This system also yielded G(thermal H·) = 1.78, $G(CH_3\cdot) = 0.41$ and G(primary $C_2H_5\cdot$) = 3.53. The molecular yields of ethylene and butane were found to be 1.83 and 0.32, respectively. The effect of C_2D_4 on the C_5 and C_6 product distribution indicated that these products were formed by alkyl radical addition to unsaturated products. The possibility of C_2D_4 reacting with hot H atoms and undergoing charge transfer reactions was also considered. Radiolysis of $C_2H_4-C_2D_4-C_2H_6$ solutions indicated that ethylene decreased the yield of hot hydrogen atoms. The effect of C_2D_2 and O_2 on the product distribution further confirmed the results of the $C_2D_4-C_2H_6$ radiolyses. From the radiolysis of $N_2O-C_2H_6$ solutions it was concluded that the scavenging of electrons by N_2O is a diffusion-controlled process and the yield of free electrons is zero. Enhanced yields of C_2H_4 and C_4H_{10} in the presence of N_2O were attributed to N_2O decreasing the yield of thermal H atoms and increasing the yields of molecular ethylene and primary ethyl radicals. These results and the effect of CO_2 on the $N_2O-C_2H_6$ system indicated that O^- or O_2^- are precursors of ethylene and primary ethyl radicals. N_2O was found to decrease both the molecular and bimolecular yields of hydrogen. SF_6 was found to be a slightly less efficient electron scavenger than N_2O. Proton transfer from $C_2H_5^+$ to ND_3 was observed in $ND_3-C_2H_6$ radiolysis. The changes in the yields of C_2H_4 and C_4H_{10} effected by ND_3 implied that neutralization of the parent ion by an electron results in the formation of ethylene but not an ethyl radical. (Diss. Abstr.)

2318 DETERMINATION OF AVERAGE MOLECULAR MASSES OF ORGANIC NUCLEAR COOLANTS. III. DIFFERENTIAL CRYOSCOPY WITH THERMOELECTRIC THERMOMETER. Becerro, E.; Carreira, M. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 283-8(Mar. 1968). (In Spanish).

The solubility problems raised by some components of the polymeric residue of irradiated polyphenylic coolants, which make it necessary to operate with very small samples, were solved by means of a differential cryoscopic technique using a thermoelectric thermometer (thermal) as the sensitive element. The method is based on the direct measurement of the difference between the freezing points of the investigated solution and of a reference solution whose concentration may be changed at will. The change of ΔV(mV) versus c(molal) is linear, the equivalent point being determined either analytically or graphically depending on the required accuracy. The method was tested by measurements on pure polyphenyls, using diphenyl ether as solvent. It was also applied to the main prospective coolants for the DON reactor. Working with 10^{-2} molal solutions the accuracy is better than ±2%. (auth)

2319 RADIOINDUCED FREE RADICALS IN PHOSPHO-ORGANIC COMPOUNDS, RADICAL YIELDS, AND RADICAL KINETICS IN PHOSPHONIC ACID ESTERS OF THE TRICHLORPHON TYPE AFTER X IRRADIATION. Lassmann, G.; Damerau, W.; Lohs, Kh. (Institut fuer Biophysik, Berlin). Z. Naturforsch., 23b: 771-7(June 1968). (In German).

Chlorine containing phosphonic acid esters (trichlorphon-type) were investigated quantitatively by ESR after x-irradiation at room temperature. Radical yields were between 0.2 and 1.7 radicals per 100 eV. In the case of trichlorphon the radical concentration was 7.5×10^{18} spins per gram at 40 MRad. Stabilization and kinetics of radiation-induced radicals in the solid state matrix at high irradiation doses in dependence of storage time, oxygen-effect, and temperature are discussed. The obtained results suggest a model for the behavior of the matrix at high irradiation doses. According to this model the lattice of molecular crystals is modified by the accumulation of recombination products arising from the induced radicals. These lattice imperfections cause a diminution of stabilizing properties for the radicals. The decrease of the dose-yield-curve at higher doses than 40 MRad and the dose-dependent radical kinetics during storage can be explained by this model. (auth)

2320 ESR AND OPTICAL SPECTROSCOPIC STUDIES OF INTERMEDIATES FORMED IN THE γ-RADIOLYSIS OF SOLID ALKYL HALIDES AT 77°K. Egland, Richard James. Madison, Wis., Univ. of Wisconsin, 1968. 275p.

Thesis.

The anomalous ESR spectra observed in some γ-irradiated polycrystalline alkyl iodides is explained, and halogen-containing intermediates in γ-irradiated glassy and polycrystalline alkyl iodides, bromides, and chlorides were detected. New information, including the effects of isotopic labeling, is reported on the ESR spectra of irradiated polycrystalline n-alkyl iodides containing an even number of C atoms, previously found to be different from the spectra in crystalline odd-C-numbered n-alkyl iodides. The evidence suggests that the central portion of the spectra of polycrystalline even-C-numbered n-alkyl iodides may be due to RI^+, RI^-, $(RI)_2^+$, $(RI)_2^-$, $C_nH_{2n}I$, or R radicals trapped close enough to neighboring RI molecules so that I and H nuclei in these molecules contribute hf structure to the ESR spectrum, or a combination of these species. Comparison of "odd-even effects" in the thermodynamic properties of crystalline n-alkanes (in which "odd-even" differences in crystal structure have been found) with those of n-alkyl iodides suggests that the differences in ESR spectra of crystalline "even" and "odd" n-alkyl iodides are a result of differences between the molecular packing in different crystalline forms. The ESR spectra of irradiated polycrystalline n-alkyl bromides and n-alkyl chlorides from C-2 to C-7 show no "odd-even effect." New ESR spectra tentatively assigned to X_2^- have been discovered in γ-irradiated solid alkyl halides, using

higher spectrometer sensitivities, and magnetic field strengths above and below those used for the central region of the spectra. These spectra extend over 4000 gauss in alkyl iodides, 2800 gauss in alkyl bromides, and 600 gauss in alkyl chlorides, and are similar to the spectra of X_2^- in γ-irradiated polycrystalline alkali halides containing 0.1 mole % $AgNO_3$. A portion of the ESR spectrum in glassy C_2H_5I and in glassy and polycrystalline C_2H_5Br below the central C_2H_5 spectrum may be due to C_2H_4X, $(C_2H_5X)_n^+$, $(C_2H_5X)_n^-$, or $C_2H_5X \cdot C_2H_5$. In the alkyl halides whose central ESR spectra are due to alkyl radicals, the orientation of β-protons in these radicals depends upon the particular trapping matrix, and in several cases this orientation changes with time at 77°K or at higher temperatures. The G-values for production of the central ESR spectra in glassy C_2H_5I, polycrystalline C_2H_5I, glassy n-C_4H_9I, and polycrystalline n-C_4H_9I were measured to be 2.2 ± 0.4, 7.5 ± 2.8, 0.9 ± 0.3, and 5.0 ± 0.1, respectively. γ-irradiation induced at least two and perhaps three optical absorption peaks in polycrystalline C_2H_5I in the visible wavelength region, which absorption seems to be due to species different from those which were observed in γ-irradiated glassy C_2H_5I. (Disser. Abstr.)

2321 DELOCALIZATION OF ELECTRONS CAPTURED IN γ-IRRADIATED AQUEOUS ALKALI GLASS AT 77°K. Ershov, B. G.; Grinberg, O. Ya.; Lebedev, Ya. S. (Inst. of Physical Chemistry, Moscow. Inst. of Chemical Physics, Moscow). Zh. Strukt. Khim., 9: 694-8(July-Aug. 1968). (In Russian).

An attempt was made to evaluate by the direct method (independent of the Σa_H magnitude) the number of protons interacting with electrons. Studies were carried out with 10M KOH and NaOH frozen at 77°K to produce transparent glass. The specimens were irradiated with ^{60}Co γ rays at 77°K. The absorbed dose was ~10^{19} eV/g. EPR spectra were obtained at 77°K. The EPR spectrum of captured electrons was a narrow symmetric band with the g factor equal to 2.001 ± 0.001. The line width (ΔH_i) measured at maximum dip was tabulated. Data obtained show that electrons produced by ionizing radiation in aqueous alkali glass at low temperature are stabilized in local electron centers with one solvated layer of water molecules (four molecules) representing the area of effective delocalization of captured electron. (R.V.J.)

2322 STABILIZED Ag ATOMS FORMED DURING IRRADIATION OF FROZEN SALT SOLUTIONS IN AROMATIC COMPOUNDS. Zhitnikov, R. A.; Mel'nikov, N. I.; Orbeli, A. L. (Leningrad Inst. of Physics and Tech.). Zh. Strukt. Khim., 9: 616-20(July-Aug. 1968). (In Russian).

Stabilized silver atoms formed by ion reduction were observed at 77°K in x-irradiated frozen $AgClO_4$ solutions in various aromatic compounds. Paramagnetic resonance spectra of the stabilized atoms were obtained. Splitting of the hyperfine structure and g-factors were determined. Properties of Ag atoms stabilized in various aromatic compounds (benzene, toluene, and meta-xylene) were compared. (R.V.J.)

2323 METHOD FOR PRODUCING FOAMED POLYSTYRENE MOLDINGS. Kawamatsu, Toshiharu (to Hitachi Ltd.). Japanese Patent 1968-14335. June 17, 1968. Filed July 4, 1964.

The method proposed has the following advantages: nondeformation of the products, e.g., plate or sheet; superior mechanical and chemical properties, due to cross-linking of the products; and efficient use of radiation. The molding, composed of polystyrene (or its derivative), a functional monomer, and a foaming agent, is irradiated with 1 to 10 MRad of radiation, at temperatures of nondissociation of the foaming agent, in order to cross-link the resin. Then, by heating, the foaming agent is dissociated, to give the foamed product. Or, alternatively, the heating for dissociating of the foaming agent is done while the molding is irradiated with radiation. (NSA of Japan)

2324 THERMOLUMINESCENCE AND LUMINESCENCE OF $PbCl_2$. Bettinali, C.; Ferraresso, G.; Pacelli, E. (Univ., Rome). J. Chem. Phys., 49: 3725-7(Oct. 15, 1968).

The luminescence of x-irradiated $PbCl_2$ and the luminescence of the same compound excited by short uv (2537 Å) light and by x irradiation are reported. The measurements were carried out using a constant heating rate of 5°/min. From the results it was found that: the ratio between the luminous intensity of the peaks at 126 and 180°K was constant when measured using a series of interference filters; the heating of the sample at 573°K for about 10 hr decreased the intensity of luminous emission (about 80%) but did not alter the ratio between the intensity of the two peaks; grinding the sample preheated at 573°K did not serve to return the thermoluminescence intensity to the intensity values of the nonheated sample; and the thermoluminescence intensity was directly proportional to the irradiation dose when varied between 100 and 2000 R. From studies on activation energy, it was found that the first and second peaks are due to tunneling processes. (P.C.H.)

2325 THERMAL EXCHANGE AND THERMAL ANNEALING IN RADIOCOBALT DOPED AND NEUTRON IRRADIATED TRIS-DIPYRIDYL Co(III) PERCHLORATE TRIHYDRATE RESPECTIVELY. Khorana, S. (Bhabha Atomic Research Center, Trombay, India). J. Inorg. Nucl. Chem., 30: 2595-9(Oct. 1968).

$^{57}Co^{2+}$ doped trisdipyridyl Co(III) perchlorate trihydrate was irradiated with thermal neutrons, the thermal exchange of the $^{57}Co^{2+}$ was compared with the thermal annealing of the recoil and ^{60}Co, in the doped irradiation complex. Both processes were found to follow almost identical kinetics. From this it was concluded that the recoil cobalt stabilizes predominantly as Co^{2+}. The chemical kinetics of thermal exchange were studied in some detail. (auth) (UK)

2326 RECOIL REACTIONS OF ATOMIC CARBON IN SYSTEMS OF SIMPLE OXYGEN CONTAINING ORGANIC MOLECULES. Palino, Gerard Francis. Contract W-7405-eng-82. Ames, Iowa, Iowa State Univ., 1968. 125p. (IS-T-216). Thesis.

The dose and scavenger dependence of the yields of ^{11}C recoil products were determined for liquid methanol, ethanol, 1-propanol, 2-propanol, acetone, diethyl ether, methyl acetate, and methyl formate. The recoil carbon was produced in situ by the $^{12}C(\gamma,n)^{11}C$ reaction using the bremsstrahlung beam from an electron synchrotron. The labeled products were analyzed using standard radio-gaschromatographic techniques. The results are interpreted in terms of the reactions of ^{11}C, ^{11}CH, $^{11}CH_2$, and $^{11}CH_3$ with the parent compound and the reactions of these radicals, other radical intermediates, or product molecules with radiation produced radicals or added scavengers. In all systems studied, radiation modification of the primary products was observed. For methanol and ethanol, where a study of the complete product spectrum was attempted, relationships were established between a number of the dose dependent products. In methanol, the solvated electron and the $\cdot CH_2OH$ radical were shown to be the primary radicals responsible for the dose dependence of the yields of labeled products: CO, CO_2, acetaldehyde, and 1,2-propanediol. The intermediate carbenes insert more readily in the O–H than in the C–H bond. No evidence was obtained for the insertion of methyne or carbene radicals in the C–O bond, although C atoms appear to react with this bond. This reaction may be by way of a cyclic intermediate, thus accounting for the production of acetaldehyde and methyl acetate in methanol. A complete reaction scheme was proposed for the reactions of recoil carbon with methanol. The ethanol data were interpreted in light of the proposed reaction sequence in methanol. However, because of the increased complexity of this system, a detailed analysis was more difficult. The influence of molecular structure on the yields of the C_1 and C_2 products was studied in all of the compounds. (Diss. Abstr.)

2327 METHOD FOR PRODUCING ALCOHOLS INCLUDING A POLYFLUORO FOUR-MEMBER RING. Muramatsu, Hiroshige (to Chief of the Agency of Industrial Science and Tech.). Japanese Patent 1968-12344. May 24, 1968. Filed Mar. 26, 1965.

By the method proposed, alcohols with a hexafluorocyclobutyl group can be produced economically. To obtain an alcohol with a hexafluorocyclobutyl group with the formula $CF_2CF_2CHFCFCRR'(OH)$ a mixture of perfluorocyclobutene and an alcohol of general formula CHRR'OH (where R and R' are hydrogen atoms, methyl group, or ethyl group) is irradiated with gamma rays to bring about the reaction of the two. (NSA of Japan)

2328 CHEMICAL BEHAVIOUR OF ^{35}S IN NEUTRON-IRRADIATED SODIUM CHLORIDE. Chiotan, C.; Zamfir, I.; Costea, T. (Inst. of Atomic Physics, Bucharest). J. Inorg. Nucl. Chem., 30: 2857-9(Oct. 1968).

It was previously reported that neutron-irradiated NaCl crystals previously degassed and dried at 130°C showed an anomalous behavior. The isothermal annealing curves representing the variation of $^{35}S^{2-}$ percentage with the time of heating, had a peak in contrast with those obtained in the case of KCl, which only showed a monotonous increase. This behavior of the recoil radiosulphur was attributed to traces of water in the target material. The studies described verified this hypothesis. (auth)

2329 IONIZATION OF LIQUIDS BY RADIATION STUDIED BY THE METHOD OF PULSE RADIOLYSIS. I. SOLUTIONS OF N,N,N',N'-TETRAMETHYL-p-PHENYLENEDIAMINE IN HYDROCARBONS. Capellos, C.; Allen, A. O. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 72: 4265-8(Nov. 1968).

TMPD (N,N,N',N'-tetramethyl-p-phenylenediamine), irradiated in cyclohexane or isooctane solution by a pulsed electron beam, gives a transient absorption that can be resolved into a triplet state of TMPD, which disappears in a first-order reaction, and the radical ion $TMPD^+$, which disappears in a second-order reaction. The yield of the triplet increases with TMPD concentra-

tion, but the yield of the ion is independent of solute concentration. In cyclohexane, the $TMPD^+$ yield is equal within experimental error to the yield of ions escaping initial recombination in the pure solvent (as determined by electrical measurements), showing that essentially all ions formed in cyclohexane readily transfer charge to TMPD, but in 2,2,4-trimethylpentane the $TMPD^+$ yield is significantly lower than the yield of ions formed in the solvent. (auth)

2330 SOME RADICAL REACTIONS WITH AMINO ACIDS IN AQUEOUS SOLUTIONS. Volkert, Wynn Arthur. Columbia, Mo., Univ. of Missouri, 1968. 164p.
Thesis.

Two different methods were developed to measure the relative reaction rates of two radicals with amino acids in aqueous solutions. A photolytic method was used to measure Arrhenius parameters for the reaction of methyl radicals with amino acids. The methyl radicals were produced by the photolysis of dilute aqueous solutions of acetone with a low pressure mercury vapor coil lamp which produces a dominant wave length of 2537 A. Since the photolysis of aqueous solutions of acetone is not well understood, some studies involving the parameters which might affect methyl radical production were investigated. A kinetic investigation of the action of methyl radicals on the pure acetone in water was carried out at different temperatures to determine the apparent validity of the method. The resulting data gave a good fit with the kinetic equation derived from a postulated mechanism which was believed to include only the important reactions involving the methyl radical. An activation energy measured for the abstraction of hydrogen from acetone by the methyl radical was 8.4 kcal/mole which is reasonable for a reaction of this kind. The first step in application of this method to obtain valid Arrhenius parameters for amino acids was carried out using alanine. The activation energy for abstraction of hydrogen atom from alanine by a methyl radical in aqueous media was measured to be 9.3 kcal/mole, and the preexponential factor measured to be 4.71. These results are representative of the activation energies and pre-exponential values expected for reactions of this type. The gas chromatographic measurements of the predominant gaseous products were the only analysis necessary to obtain the results. The ^{60}Co γ radiolysis of acidic aqueous solutions of amino acids and related compounds were carried out in order to determine relative rates of H atom reactions with these compounds. These relative rates were measured by competition of H atom donor and scavenger species for the H atoms produced. Rate constant ratios were evaluated by a graphical technique utilizing the variation of $G(H_2)$ with solute concentration. The H atom donor species were competed with allyl alcohol while the aromatic and sulfur containing acids which serve as H atom scavengers were competed with formic acid. Absolute rate constants were derived using known rates for various competitors. Rate constants derived were in the range of 10^5 to 10^6 l/mole-sec for abstractions and ca. 10^9 l/mole-sec for additions. The amino acids were selected so the effect of substituents on the side chain could be studied. Decompositions were kept below 0.1% to avoid scavenging of H atoms by reaction products which result from the H atom and OH radical attack on the species. Electrons were scavenged by H_3O^+ and did not contribute significantly to the overall decomposition. (Disser. Abstr.)

2331 CROSS-LINKING OF POLYSTYRENE BY HIGH-ENERGY RADIATION. II. MOLECULAR WEIGHT CHANGES IN THE PREGEL REGION. Alberino, Louis M.; Graessley, William W. (Northwestern Univ., Evanston, Ill.). J. Phys. Chem., 72: 4229-35 (Nov. 1968).

The radiation-cross linking properties of polystyrene were determined for samples ranging in $\bar{M}_w$ from 50,000 to 3,000,000. The polymers were prepared by bulk and solution polymerizations. Both $\bar{M}_n$ and $\bar{M}_w$ were measured as functions of γ-radiation dose in the pregel region, and the results were used to determine the G-values for random crosslinking, G(X), and chain scission, G(S). Variations of G(X) with initial molecular weight were sought which would yield information on intramolecular crosslinking and chain dimensions in the solid. No observable trend in the values could be found, leading to the conclusion that chain dimensions are at least as large in the solid as in the θ solvent. A reaction additional to random crosslinking and scission was observed in the solution-polymerized samples. The relative changes in $\bar{M}_n$ and $\bar{M}_w$ suggested a reaction involving the end groups of the molecules. (auth)

2332 REACTION OF SULFUR HEXAFLUORIDE WITH HYDRATED ELECTRONS. Asmus, K.-D.; Fendler, J. H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem., 72: 4285-9 (Nov. 1968).

The reaction of SF_6 with e^-_{aq} in irradiated aqueous solutions leads to F^-, SO_4^{2-}, and H_3O^+ as stable products via an intermediate with oxidizing properties. The rate constant for this reaction has been determined to be $k_{(SF_6+e^-_{aq})} = 1.65 \times 10^{10}$ M^{-1} sec^{-1}. Since $G(F^-) = 16.55$ was obtained in buffered (pH ~ 6.5) solutions and the suggested mechanism requires the formation of $6F^-$ from every molecule of SF_6 in its reaction with e^-_{aq}, $G(e^-_{aq}) = 2.76$ was calculated. The yield of SO_4^{2-} ion amounts to $\frac{1}{6}G(F^-)$ and therefore is equal to the yield of e^-_{aq} which is scavenged by the SF_6. The SO_4^{2-} ion results from the reoxidation of the sulfur from a lower oxidation state. Owing to the specificity of SF_6 as an e^-_{aq} scavenger and the high F^- yield, this system can be conveniently used for the determination of relative rate constants in e^-_{aq} scavenging competition studies. (auth)

2333 PRODUCTION OF NUCLEAR FISSIONABLE MATERIALS AND THEIR APPLICATIONS. Awwal, M. A. (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., 4: 25-33 (Apr. 1968).

Methods for the production of ^{235}U, ^{233}U, and ^{239}Pu are described. (M.C.G.)

2334 IMPROVEMENT OF QUALITY OF JUTE FIBER AND TIMBER BY USING GAMMA RADIATION. Shamsul, A. K. M.; Khalilur Rahman, M. (Atomic Energy Centre, Dacca, Pakistan). Nucl. Sci. Appl., 4: 21-4(Apr. 1968).

The grafting of vinyl monomers on jute fiber was investigated. A 500-Ci ^{60}Co source with a dose rate of 500 rads/min was used. The fibers were irradiated in a monomer solution. Grafted jute fibers were more water repellent and resistant to fungal attack than ungrafted fiber. The preparation of wood plastic materials by gamma irradiation was also studied. (M.C.G.)

2335 OBTAINMENT OF ^{64}Cu BY THE REACTION (n,p). Lopez, F. Hernandez; Gomez, M. Barrachina (Junta de Energia Nuclear, Madrid). An. Quim., 64: 751-5(July-Aug. 1968). (In Spanish).

A new method for the production of ^{64}Cu from Zn irradiated with fast reactor neutrons is described. Copper-64 is separated from the target material by extraction of the complex Cu(I)-neocuproine into chloroform. The radioactive product is finally purified by an anion exchange chromatographic step. The main characteristics of the ^{64}Cu solution obtained by this method are the following: ^{64}Cu recovery yield ≃ 95%, specific activity > 400 Ci/g, radioactive density ≃ 1.5 mCi/ml, and nuclear yield ≃ 4 mCi/g Zn. (auth)

2336 DEVELOPMENT OF NEW RADIONUCLIDE PREPARATIONS FOR MEDICAL AND BIOLOGICAL RESEARCH. Hupf, H. B.; Lewis, R. E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 475 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2337 PREPARATION OF CURIE QUANTITIES OF ^{153}Gd HAVING HIGH ISOTOPIC AND CHEMICAL PURITY. Acree, E. H.; Case, F. N.; Cutshall, N. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 454-5 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2338 THE APPLICATIONS OF IONIZING RADIATIONS IN THE CHEMICAL AND ALLIED INDUSTRIES. Joint Symposium Held at Imperial College, London, September 27, 1967. London, The British Nuclear Energy Society, 1968. 74p. (CONF-670906).

Topics covered by the 7 papers include: radiation chemistry, industrial polymer irradiation, coatings and wood plastics, review of industrial radiation chemistry in the United States, transition of radiation chemistry to an industrial reality by the Dow ethyl bromide process, economic assessments of gamma radiation plant, and industrial applications of electron accelerators. Discussions of the papers are also included. (M.C.G.)

2339 KINETICS OF THE GAMMA-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE IN TERT-BUTYL ALCOHOL. Suganuma, Fujio; Mitsui, Hiroshi; Machi, Sueo; Hagiwari, Miyki; Kagiya, Tsutomu (Takasaki Radiation Chemistry Research Establishment, Gunma, Japan). J. Polym. Sci., Part A-1, 6: 3127-37(Nov. 1968).

The gamma-induced polymerization of ethylene in the presence of 13 to 30 ml of tert-butyl alcohol was carried out under a pressure of 120 to 400 kg/cm^2 at a dose rate of 1×10^3 to 2.5×10^4 RAD/hr at 30°C with a 100 ml reactor. The polymerization rate and the molecular weight of the polymer increased with reaction time and pressure and decreased with amount of tert-butyl alcohol. The polymer yield increased almost proportionally with the dose rate, while the molecular weight was almost independent of it. These results were graphically evaluated, and the rate constants of initiation, propagation, and termination for various

conditions were determined. No transfer was observed. On the basis of these results the role of tert-butyl alcohol in polymerization is discussed. (auth)

2340 TRAPPED ELECTRONS IN γ-IRRADIATED POLYCRYSTALLINE n-HYDROCARBONS STUDIED BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Iwasaki, Machio; Toriyama, Kazumi; Ohmori, Toshio (Government Industrial Research Inst., Nagoya, Japan). Phys. Chem., 72: 4347-8(Nov. 1968).

The ESR signal due to trapped electrons in polycrystalline hydrocarbons irradiated with gamma radiation at 77°K was measured. Experiments strongly suggest that the nonpolar organic crystalline solids are capable of trapping the electrons produced by irradiation. (M.C.G.)

2341 RADIOLYSIS OF AQUEOUS SOLUTIONS BY HEAVY PARTICLE RADIATIONS. I. RADIOREDUCTION INDUCED BY THE NUCLEAR REACTION $^{10}B(n,\alpha)^7Li$ IN SULFURIC ACID SOLUTIONS OF Ce(IV) IN THE PRESENCE OF Tl(I) AND OF Ce(III). Sigli, Paul (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France); Pucheault, Jacques. J. Chim. Phys., 65: 1543-50(Sept. 1968). (In French).

The reduction yield of Ce(IV) under the effect of the recoil particles from $^{10}B(n,\alpha)^7Li$ reaction is G(Ce(III)) = 2.94 ± 0.15 mol/100 eV. When thallium is present in irradiated solutions, the yield varies as a function with the concentration of $(Tl^I)_0$. It increases when Tl^I enters into competition with Ce(III) for OH radicals as in the case of ^{60}Co γ ray irradiations. After a maximum, it decreases from when G(Ce(III)) = 3.25 ± 0.15 mol/100 eV passing by an intermediate step where G(Ge(III)) = 2.80 ± 0.10 mol/100 eV. This decrease is quantitatively interpreted in terms of radical and molecular yields and of the participation of intra-track reactions for this type of high LET radiations. (auth)

2342 MASS SPECTROMETRIC INVESTIGATION OF MINOR PRODUCTS IN THE RADIOLYSIS OF LIQUID CYCLOPENTANE. Hughes, B. Mason; Hanrahan, Robert J. (Univ. of Florida, Gainesville). Radiat. Res., 36: 261-73(1968).

The following substances were identified as minor products in the ^{60}Co γ radiolysis of liquid cyclopentane at 3×10^{22} eV total dose: 1,4-pentadiene; 2-pentene; cyclopentadiene; 1,3-pentadiene; ethyl cyclopentane; vinyl cyclopentane; n-heptane; n-octane; propyl cyclopentane; propenyl cyclopentane or propyl cyclopentene; n-decane; pentenyl cyclopentane or n-pentyl cyclopentene; n-pentyl cyclopentane; and cyclopentyl cyclopentene. The determination of these products was by parent mass number, gas chromatographic retention times, and/or boiling points of the compounds. Ultraviolet spectroscopic studies of the radiolysis of solutions of cyclopentadiene in cyclopentane are also described. (auth)

2343 ELECTRON SPIN RESONANCE OF X-RAY IRRADIATED SINGLE CRYSTALS OF AMMONIUM PARAMOLYBDATE TETRAHYDRATE. Byfleet, C. R.; Herring, F. G.; Lin, W. C.; McDowell, C. A.; Ward, D. J. (Univ. of British Columbia, Vancouver). Mol. Phys., 15: 239-48(1968).

The paramagnetic species produced by x irradiation of single crystals of ammonium paramolybdate $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ was studied by ESR spectroscopy. Only one of the seven Mo nuclei was seen to give rise to hyperfine coupling with the spin of the unpaired electron. The hyperfine coupling tensor and the g tensor were found to have different principal axes, and a general method is presented for their determination. The electronic structure of the paramagnetic species is discussed in terms of molecular orbital theory in a semi-quantitative manner. The bonding coefficient, α, for the odd electron orbital, and the contact spin density, χ, were estimated and compared with values for the related molybdenum complex anions. (auth) (UK)

2344 MEASUREMENT OF $H^{14}CN$ IN HCN PRODUCED BY FISSION FRAGMENT IRRADIATION OF NITROGEN AND METHANE. Arino, H.; Kramer, H. H.; Osterholtz, F. D.; King, P. A. (Union Carbide Corp., Tuxedo, N. Y.). Int. J. Appl. Radiat. Isotop., 19: 799-800(Nov. 1968).

Fission-fragment irradiation of N_2-CH_4 mixtures produced HCN, some of which was $H^{14}CN$. Since the total ^{14}C activity in the product equaled the activity predicted by the $^{14}N(n,p)^{14}C$ reaction, all of the ^{14}C atoms appeared as $H^{14}CN$. Radiochemical procedures are described for separating volatile fission products from the HCN and for determining what fraction of the HCN product is $H^{14}CN$. (auth) (UK)

2345 ABSTRACTION OF HYDROGEN AND CHLORINE ATOMS BY HOT AND THERMAL METHYL RADICALS PRODUCED FROM THE PHOTOLYSIS OF METHYL IODIDE IN THE GAS PHASE. IDENTIFICATION OF ALKYL RADICALS PRODUCED BY IRRADIATION OF BRANCHED-ALKANE GLASSES AT 77°K. Henderson, Don Jordan. Madison, Wis., Univ. of Wisconsin, 1968. 274p.

Thesis.

Reactions of thermal methyl radicals with ethyl chloride were studied by photolyzing methyl iodide in the presence of ethyl chloride and a large excess of an inert moderating gas. The purpose was to determine the relative importance of Cl and H atom abstraction. At 108°C, hydrogen atoms are abstracted at least 2,500 times more rapidly than chlorine atoms from ethyl chloride. The difference in activation energies of these two reactions, $E_{Cl} - E_H$, is estimated to be greater than 6 kcal $mole^{-1}$, assuming equal pre-exponential factors. Use of powdered silver in the reaction cell to scavenge iodine was tested but discontinued as it catalyzed the formation of methyl chloride. To determine the reactivity of the hot (32–36 kcal $mole^{-1}$) methyl radicals produced in the primary decomposition of methyl iodide, the reaction mixtures were saturated with iodine to scavenge all thermal radicals. Absolute reaction probabilities were deduced from gas chromatographic analysis of the reaction products, using the photolysis of methyl iodide in the absence of additive as an actinometer. For hot methyl radicals formed by 2537 Å light, the relative probability (per atom) of abstraction of a hydrogen or chlorine atom, compared to abstraction of a hydrogen atom from ethane, is: C_2H_5-Cl, 0.86; CH_3CHCl-H, 2.6; CH_2ClCH_2-H, 0.18; CH_2ClCH_2-Cl, 1.0; CH_3CHCl-H, 4.0; $CH_3CH_2CH_2$-H, 1.0; $(CH_3)_2CH$-H, 3.9. The addition of inert gas, or photolysis at 3130 Å, reduces the overall quantum yields, but does not significantly affect the relative rates of hydrogen and chlorine abstraction from ethyl chloride. Ethylene, chloroethylene, and dichloroethanes were produced in addition to the expected reaction products. The identity of trapped alkyl radicals produced by irradiation of glassy branched alkanes at 77°K was established. The six-line ESR spectrum resulting from γ-irradiation of 3-methylpentane (3-MP) glass at 77°K is ambiguous with respect to whether a secondary hydrogen, a tertiary hydrogen, or the 3-methyl group was removed from the parent molecule. Determination of its assignment is of particular interest because the same spectrum is produced by hot reactions resulting from the photolysis of dilute solutions of alkyl iodides, HI, Cl_2, or aromatic sensitizers in 3-MP. Identification of the spectrum as that of the sec-3-methylpentyl radical was accomplished by comparing it with the ESR spectrum of each of the four isomeric 3-methylpentyl radicals produced by radiolysis of the corresponding 3-methylpentyl iodides and chlorides at 77°K. A systematic investigation of similar branched-alkane glasses shows that the relatively weak tertiary C-H bond is not preferentially broken. The following generalization is suggested: the radical stabilized in branched-alkane glasses at 77°K as a consequence of γ radiolysis or hot atom or hot radical attack, results from loss of a secondary hydrogen atom from a $-CH_2CH_3$ group in the longest hydrocarbon chain; when the side-chain is on a number two carbon, tertiary radicals are also formed due to loss of tertiary hydrogens. Different ways of selectively producing known radicals in glassy matrices at 77°K are reported. (Disser. Abstr.)

2346 THE γ-RADIOLYSIS OF CYCLOHEXANE WITH ELECTRON SCAVENGERS. V. C_6F_{12} AS AN ELECTRON SCAVENGER IN THE VAPOR PHASE. Sagert, N. H.; Blair, A. S. (Chalk River Nuclear Labs., Ont.). Can. J. Phys., 46: 3284-6(Oct. 15, 1968). (AECL-2729).

The radiolysis of cyclohexane in the vapor phase has been examined in the presence of up to 3 mole % perfluorocyclohexane. The results indicate that perfluorocyclohexyl radicals are produced with a yield of 2.0 G units at 3% perfluorocyclohexane. It was concluded that these radicals are formed when the perfluorocyclohexyl anions are neutralized. The relevance of this neutralization to the liquid phase radiolysis of cyclohexane is discussed. (auth) (Canada)

2347 INCORPORATION OF HYDROGEN INTO PRODUCTS OF THYMINE RADIOLYSIS. Drasil, V.; Ryznar, L.; Juraskova, V. (Inst. of Biophysics, Brno). Biochim. Biophys. Acta, 166: 600-2(Sept. 24, 1968).

Incorporation of ^3H and O^3H in products from the radiolysis of thymine was investigated by γ irradiation of thymine dissolved in ^3H_2O. The total radiation dose was 2×10^6 rads. After elimination of exchangeable tritium, thymine and its radiolytic decomposition products were chromatographed and the distribution of tritium activity among the products analyzed. The assumption that ^3H will be incorporated only in dihydrothymine and its monohydroxy derivatives was not confirmed. Some of the reactions during continuing irradiation led to the reformation of thymine. (M.C.G.)

2348 PROTECTIVE ACTION OF PROPYL GALLATE IN THE RADIOLYSIS OF AQUEOUS DNA SOLUTIONS. Nadzhimiddinova, M. T.; Sharpatyi, V. A.; Kruglyakova, K. E.; Emanuel, N. M. Dokl. Akad. Nauk SSSR, 182: 1354-7(Oct. 21, 1968). (In Russian).

The mechanism of inhibiting effects of propyl gallate in radiol-

ysis of DNA aqueous solutions was studied using a low-temperature radiolysis and EPR method in order to fix the radical conversions. The constructed curves showed that with the temperature rise from −196 to −160° the OH radicals disappear while the concentration of R_{DNA} and R_{pg} in general remains unchanged. Further, as the temperature rises from −100 to −80° the total concentration of R_{DNA} and R_{pg} remained unchanged, but the concentration of R_{DNA} decreased and R_{pg} increased. Data are given for the yield of radicals in irradiated frozen aqueous solutions of DNA in propyl gallate and p-benzoquinone at various irradiation temperatures. (R.V.J.)

2349 γ-RADIOLYSIS OF CYCLOHEXANE WITH ELECTRON SCAVENGERS. VI. N_2O AND SF_6 AS ELECTRON SCAVENGERS IN THE VAPOR PHASE. Sagert, N. H.; Robinson, R. W.; Blair, A. S. (Atomic Energy of Canada, Chalk River, Ont.). Can. J. Chem., 46: 3511-16(Nov. 15, 1968). (AECL-2739).

The γ-radiolysis of cyclohexane was examined in the vapor phase using N_2O and SF_6 as electron scavengers. Both N_2O and SF_6 reduce the hydrogen yield from 4.6 to 3.0 G units, indicating that 3.0 G units of hydrogen have neutral species as precursors, while 1.6 G units have electrons as precursors. Radiolysis of cyclohexane vapor with more than 2% N_2O produces 10.4 G units of cyclohexene and 11.5 of nitrogen. Carbon dioxide reduces both these yields; the extrapolated value of $G(N_2)$ is equal to G(electrons) at infinite CO_2 concentration. Thus O^- is likely a precursor of that part of the nitrogen yield in excess of G(electrons), and of the cyclohexene yield associated with this nitrogen yield. The first order molecular detachment of hydrogen is unaffected by electron scavengers, showing that most of this first order yield has neutral precursors. The implications for Dyne's general mechanism of hydrocarbon radiolysis are discussed. (auth) (Canada)

2350 RADIOLYSIS OF BINARY MIXTURES. PART IV. THE EFFECT OF POLYCYCLIC AROMATIC ADDITIVES IN METHANOL. Ekstrom, A.; Garnett, J. L. (Univ. of New South Wales, Kensington, Australia). J. Chem. Soc., A, No. 10, 2416-18(1968).

The effects of a series of polycyclic aromatic additives on the radiolysis yields of products from methanol were examined. The additives studied included naphthalene, azulene, phenanthrene, fluorene, pyrene, o-terphenyl, and biphenyl. The results are interpreted in terms of the occurrence of both electron and free-radical scavenging in these solutions. The additives were found to decompose with high G values during radiolysis. The precise nature of the decomposition products has not been elucidated, but they appear to be polymeric. The decomposition of the additives is accompanied by a reverse isotope effect, this result being consistent with the extensive participation of free-radical scavenging in the protection observed in these solutions. (auth) (UK)

2351 EFFECT OF PROTON ACCEPTORS ON THE CONDENSED PHASE RADIOLYSIS OF CYCLOHEXANE-d_{12} IN CYCLOPENTANE. Stone, J. A. (Queen's Univ., Kingston, Ontario). Can. J. Chem., 46: 3531-6(Nov. 15, 1968).

C_2H_5OH decreased the HD and D_2 yields from small concentrations of c-C_6D_{12} in c-C_5H_{10}. The results were consistent with a previous suggestion that the enhanced yields in this system are due to exothermic charge transfer. Charge transfer to c-C_6D_{12} was only ~10% as efficient as proton transfer to C_2H_5OH at 4.1 mole % c-C_6D_{12} or C_2H_5OH. Experiments at 196 and 77°K suggest that resonance charge transfer in the cyclopentane matrix may occur to some extent. (auth)

2352 THE REACTIONS OF ENERGETIC $^{14}C^+$ AND $^{14}CO^+$ IONS WITH WATER. Vasudev, P. Cambridge, Eng., Univ. of Cambridge, 1968. 14p.

Thesis.

A description is given of a specially constructed mass spectrometer used in these studies. Irradiation products were analyzed by gas chromatography, in conjunction with internal flow proportional counting to obtain information on identities and yields. Ion energies were 240, 120, and 60 eV. The reactions resulted in the formation of single-carbon atom products (e.g., methanol, formaldehyde, formic acid, CO_2, and CO) in major yields. Some multi-carbon atom products were also produced in smaller amounts (e.g., acetaldehyde and 1,2-dimethoxyethane). The same species were produced in both the C^+ and CO^+ irradiations, but the relative amounts were different, indicating a difference in reactivities. The yields of methanol, formaldehyde, and formic acid were clearly dependent on energy of bombarding species, that of methanol increasing with increasing ion energy, while that of formaldehyde and formic acid decreased. A definite trend with energy was not observed for multi-carbon products. The dependence of yield on "charge density" (number of ions impinging per molecule of substrate) was of a complex nature. The observations are explained in terms of track events. (UK)

2353 DEACTIVATION OF CHROMOSORB G BY CHROMATOGRAPHY IN THE VAPOR PHASE. Martin, J.; Gasco, L. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 775-82 (July-Aug. 1968). (In Spanish).

Chromosorb G solid support was deactivated by the following methods: liquid phase saturation of active sites, elimination of silanol groups by reaction, acid washing, and inactive material coating. The effect of the deactivation of supports coated with polar and nonpolar liquid phases on column performance, and on Kovats retention indexes of some alcohols, was studied. The I minimum criterion for measuring deactivation was compared with a new criterion, "constant I values for different quantities of sample injected into the column." Problems arising from the application of these criteria were discussed. The best support deactivation was achieved either by acetic acid treatment followed by 0.05% THEED coating, or by HMDS copolymerization induced by γ irradiation. (auth)

2354 THE THERMAL ANNEALING OF β^{-1}-DECAY AND ISOMERIC TRANSITION RECOIL PRODUCTS IN TELLURIC ACID. Jones, C. H. W.; Warren, J. L. (Simon Fraser Univ., Burnaby, British Columbia). J. Inorg. Nucl. Chem., 30: 2289-2304(Sept. 1968).

The thermal annealing reactions of ^{131}I β^{-1}-decay products in ^{131}Te- and ^{131m}Te-labelled telluric acid involve the participation of crystal defects present as an inherent bulk property of the lattice. The radioactive decay process itself also influences the course of the subsequent annealing reactions. The thermal annealing of ^{129}Te isomeric transition products in ^{129m}Te-labelled telluric acid involves only defects generated in the recoil zone. (auth) (UK)

2355 RADIATION-INDUCED OXIDATION OF 2-PROPANOL BY DIALKYL PEROXIDE. Sherman, Warren V. (Univ. of Notre Dame, Ind.). J. Amer. Chem. Soc., 90: 6773-6(Nov. 20, 1968). (COO-38-608).

Solutions of di-t-butyl peroxide in 2-propanol have been subjected to ^{60}Co γ irradiation. Under alkaline conditions di-t-butyl peroxide was reduced to t-butyl alcohol and the solvent oxidized to acetone according to the stoichiometry $(t\text{-BuO})_2 + Me_2CHOH \rightarrow 2t\text{-BuOH} + Me_2CO$. Yields were independent of alkali concentration when the latter exceeded about 2×10^{-2} M, but were first order in peroxide concentration. The magnitudes of the yields indicate a chain reaction. It is proposed that the chain is initiated by radiolytic intermediates that undergo hydrogen abstraction reactions with the solvent to produce dimethylhydroxymethyl radicals (I). The latter ionize, and the resulting radical anions (II) undergo a redox reaction with di-t-butyl peroxide, decomposing it to t-butoxide and a free radical (t-butoxy) that can regenerate I from the solvent. The chain reaction exhibits a dose-rate dependence that is consistent with termination being second order in chain carrier. Retardation and inhibition were observed in the presence of compounds that may be expected to undergo nondissociative electron transfer with II (nitrobenzene, benzophenone, oxygen, sulfur hexafluoride, perfluorocyclobutane) but were not observed in the presence of neutral free radical scavengers (1-hexene, benzene) or compounds that may be expected to dissociate on electron capture (methyl bromide, bromobenzene, carbon tetrachloride, nitrous oxide). (auth)

2356 REACTIONS WITH SILANE OF SILICON ATOMS RECOILING FROM $^{30}Si(n,\gamma)^{31}Si$. Gaspar, P. P.; Bock, S. A.; Levy, C. A. (Washington Univ., St. Louis). Chem. Commun., No. 21, 1317-18(1968).

Products from the reactor neutron irradiation of normal silane are reported, together with the effects of added ethylene, phosphine, and ammonia on product yields. Yields of $^{31}SiH_4$, $^{31}SiSiH_6$, and $^{31}SiSi_2H_8$ are tabulated. The formation of trisilane is interesting, since no trisilane was detected in reactions of silane with ^{31}Si produced from phosphine by the $^{31}P(n,p)^{31}Si$ reaction. The chemistry of recoiling Si atoms thus appears to depend on their mode of formation, and factors which may be involved are discussed. The effect of added ammonia and phosphine was to increase yields, but the presence of a large amount of ethylene resulted in decreased yields. Reasons for these findings are also discussed. (UK)

2357 UNSTABLE INTERMEDIATES. PART LVI. AN ELECTRON SPIN RESONANCE STUDY OF THE RADICALS FORMED BY γ-IRRADIATION OF PYRIDINE AND SOME OF ITS DERIVATIVES. Bower, Hilary J.; McRae, J. A.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., A, No. 11, 2696-9(1968).

The ESR spectrum of the radical formed by exposure of pyridine

to γ-rays at 77°K is assigned to the 2-pyridyl radical. The magnetic properties show that the unpaired electron orbital, which is formally sp^2 on carbon, in fact includes a large contribution from the sp^2 lone-pair orbital on the adjacent nitrogen atom, making this radical structurally similar to benzene. On warming, the radical adds to another pyridine molecule. The relationship between these radicals and others that can be obtained from pyridine and pyridinium ions is discussed. (auth) (UK)

2358 THERMAL ANNEALING IN NEUTRON-ACTIVATED K_2ReBr_6–K_2ReCl_6 MIXED CRYSTALS. Mueller, Horst (Univ., Freiburg i. B.). Radiochim. Acta, 9: 167-8(Aug. 1968). (In German).

Neutron-activated mixed crystals of $K_2ReBr_6-K_2ReCl_6$ were thermally annealed and the fraction of the individual ^{186}Re recoil species was determined. The end values were obtained at the end of 30 min. annealing and additional 72 hr annealing caused no further change. The values obtained for various annealing temperatures are shown graphically. The significance of the results was discussed. (J.S.R.)

2359 PRODUCTION OF ACTIVE MOLECULAR NITROGEN BY THE REACTION OF RECOIL ^{13}N. Welch, M. J. (Washington Univ., St. Louis). Chem. Commun., No. 21, 1354-5 (1968).

Atomic ^{13}N was produced by the $^{12}C(^2H,n)^{13}N$ reaction, using a 7 MeV deuteron cyclotron beam, from CO_2, and allowed to react with various CO_2-N_2 mixtures at 760 mm. Only three products were detected chromatographically, these being ^{13}NN, ^{13}NO, and $^{13}N_2O$, the amounts being independent of radiation dose and dose rate over the ranges studied. The product spectrum was also independent of N_2 concentration. Reaction schemes are presented and discussed. It is concluded that stable products not previously isolated can be observed by the recoil technique. (UK)

2360 PREPARATION OF RADIOACTIVE CARRIER-FREE RHENIUM FROM PROTON-IRRADIATED TUNGSTEN. Gureev, E. S.; Islamov, T.; Miranskii, I. A.; Muminova, M. F.; Miroshnikov, V. S. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb., SSR, No. 7, 17-18(1968). (In Russian).

A method for separation of radioactive rhenium from tungsten is described. A proton-bombarded tungsten target was used to obtain the carrier-free isotopes ^{183}Re and ^{184}Re (with half-lives of 2.2 and 70 days, respectively). Physical properties of the isotopes obtained are analyzed. (R.V.J.)

Radiochemistry

Refer also to abstracts 2354 and 2668.

2361 (NAS-NS-3049(Rev.)) RADIOCHEMISTRY OF SILICON. Schink, David R. (Isotopes, Inc., Palo Alto, Calif.). Nov. 1968. 74p. Dep. CFSTI.

Nuclear Science Series of the National Academy of Sciences–National Research Council, Washington, D. C. Committee on Nuclear Science.

Topics covered include: nuclear properties and production of silicon isotopes, chemistry of silicon compounds, separation techniques, dissolution of samples containing silicon, analytical methods for silicon compounds, safety practices, and radiochemical practices and counting techniques for ^{31}Si and ^{32}Si. (M.C.G.)

2362 CHEMICAL EFFECTS OF THERMAL NEUTRON CAPTURE IN POTASSIUM FERROCYANURE. Meriadec, B.; Milman, M. (CEA, Saclay, France). J. Inorg. Nucl. Chem., 30: 2853-6 (Oct. 1968). (In French).

The (n,γ) reaction on potassium ferrocyanide produces a number of different chemical species containing ^{59}Fe. These were separated and identified by electrophoresis. A study of the thermal annealing process after irradiation demonstrated the existence of a unique chemical reaction by which the Fe^{2+} reforms the initial ferrocyanide molecule. The activation energy and frequency factor of this reaction were determined. (auth) (UK)

2363 THEORY OF CHEMICAL REACTIONS INVOLVING MUONIUM. Ivanter, I. G.; Smilga, V. P. Zh. Eksp. Teor. Fiz., 55: 1521-31(1968). (In Russian).

The possibility of classifying chemical reactions involving muonium and an experimental determination of the rates of these reactions are considered on the basis of the phenomenological theory of depolarization of the μ^+ meson in media. The case is considered where the reaction includes an "ordinary" channel as well as the so-called "hot chemistry" channel. The resultant products may be diamagnetic as well as long-lived ($\tau > 10^{-5}$ sec) radical states. An analysis of all possible cases is performed. In particular, the additional information that can be obtained by investigating the dependence of the polarization on time is investigated. Relations are derived that permit the reaction rates and relative importance of various channels for muonium as well as other phenomenological parameters of the depolarization theory to be determined experimentally. (auth)

2364 MONTE CARLO STUDIES OF THE USE OF BOROSILICATE-GLASS RASCHIG RINGS AS A FIXED NEUTRON ABSORBER IN SOLUTIONS OF FISSILE MATERIAL. Webster, J. Wallace (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 672-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Separation Processes

Refer also to abstracts 2186, 2208, 2209, 2233, 2234, 2243, 2361, 2412, 2413, 2541, 3123–3125, 3130, 4148, and 4164.

2365 (AEC-tr-6998) PREPARATION OF HYDROGEN ISOTOPES BY CHROMATOGRAPHY IN A MOVING BED. Clayer, Arlette; Agneray, Louis; Vandenbussche, Gerard; Petel, Pierre. Translated by Myra S. Feldman (Savannah River Lab., Aiken, S. C.), from Z. Anal. Chem., 236: 240-9(1968). 6p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 33499.

2366 (BAW-3714-8) GEL-ADDITION PROCESS CHEMICAL STUDIES. Quarterly Progress Report No. 8, May–June 1968. Dewell, E. H. (comp.) (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Sept. 1968. Contract AT(30-1)-3714. 30p. Dep. CFSTI.

The development of the sol-gel process and related processes for preparing $(U,Pu)O_2$ fast reactor fuels is described. Development of the Oak Ridge mixed sol process was expanded. The last of the scheduled test work on the gel-addition process was completed with the demonstration that Pu(III) is picked up from aqueous solution and retained by UO_2 gels through at least two mechanisms. About half the Pu(III) picked up in a single contact was leached from the gel with either water or aqueous ammonia. The remainder was fixed. The total was fixed when the gel was dried before leaching. The total pickup from a 0.45 M Pu(III) nitrate solution was 4.7% (Pu/U + Pu) in one contact. Procedures for polishing pellet specimens for ceramographic examination are nearly complete. $HF-HNO_3$ solutions give an excellent etch, but additional work is needed to find ways of stopping the etchant action at the required point. (P.C.H.)

2367 (BNWL-889) RESEARCH AND DEVELOPMENT ACTIVITIES, FIXATION OF RADIOACTIVE RESIDUES. Quarterly Progress Report, May–July 1968. Platt, A. M. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 34p. Dep. CFSTI.

Approximately 2,400,000 Ci of radioactivity were processed in the sixth phosphate glass solidification run and approximately 360,000 Ci were processed in the third spray solidification run. Phosphate glass Run PG-6 was made using sulfate-free Purex Waste 1 (PW-1) feed while SS-3 was made using sulfate-containing Purex Waste 2 (PW-2) feed. The high rare earth concentration (35 wt % as oxide) of PW-4m waste tends to raise the melting point and increase nonhomogeneity of spray solidifier melts. Satisfactory phosphate melts for the spray solidifier were only achieved by adding sodium and iron to the point where the final melt resembled PW-1 spray solidifier product. Some borosilicate systems were investigated, of which several were prepared that have "stick" temperatures above 700°C and melting points in the range 925 to 975°C. Three successful vacuum batch transfers of phosphate glass melts were made in engineering-scale equipment to test advanced solidification techniques. The water–nitric acid separation characteristics of an analog computer model of Waste Solidification Engineering Prototype (WSEP) were verified by comparison with actual WSEP data. Data from a pot calciner run were also used to adjust the parameters of the model to match data on solids entrainment and ruthenium volatility. Steady-state cooling capacities of the two WSEP product pot furnaces were calculated. The highest planned heat generation rate of 25 kW in a stainless steel pot is within the calculated furnace limits. (auth)

2368 (EURFNR-526) AQUEOUS REPROCESSING OF NUCLEAR FUELS, IN PARTICULAR THOSE WITH A HIGH PLUTONIUM CONTENT. Baumgaertner, F. (Kernforschungzentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Translation of report KFK-709. 22p. (EUR-3724). Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 48897.

2369 (GAMD–8382) CENTRAL REPROCESSING PLANT FOR HTGR FUELS. Shefcik, J. J. (Gulf General Atomic, Inc., San Diego, Calif.). Oct. 16, 1967. Contract AT(04-3)-167. 131p. Dep. CFSTI.

A conceptual design and reprocessing costs have been developed for a central reprocessing plant to recover the thorium and bred uranium from spent HTGR fuel elements. The plant is sized to serve a 15,000 MW(e) HTGR economy. Flowsheets and material balances were developed for hexagonal block HTGR fuel elements containing pyrolytic carbon coated fertile particles (thorium plus bred uranium as oxides) and silicon carbide coated fissile particles (recycle U-233 plus makeup U-235 as oxides). A plant operating on-line efficiency of 75% was assumed. A burn-leach head-end process is used to reduce the fuel elements to a solution that serves as feed to a three-cycle solvent extraction process. The plant products are a highly purified uranyl nitrate solution suitable for feed to a refabrication plant and a partially decontaminated thorium nitrate solution which is stored for Th-228 decay. The radioactive waste solutions are solidified and, after an interim storage period, are shipped to a licensed repository for disposal. The fissile particles are isolated and handled in the same manner as the solidified radioactive wastes. Reprocessing operations and maintenance are carried out remotely. Auxiliary functions such as plant administration, utilities, analytical laboratories, and maintenance shops are incorporated in the plant site. Based on present-day costs, the capital cost of the plant is estimated to be $30,803,000. Annual operating costs are estimated at $4,463,850. For a 15-year plant life, the estimated annual reprocessing charges are $10,318,000 or $62 per kilogram of thorium plus uranium in the unirradiated fuels. Some variations in the makeup of the HTGR fuels can be accommodated through flowsheet modifications. HTGR fuels containing carbide fuel particle kernels or fuels fabricated for a "bred-uranium" recycle mode can be processed at the same processing rate and, within the limits of accuracy, at the same costs. Subsequent to this study it appears that the fertile fuel particles may also have a silicon carbide coating. A modification of the reprocessing method, which is described, would then be used. (auth)

2370 (GAMD–8615) HTGR FUEL REPROCESSING: RECOVERY OF URANIUM FROM SILICON CARBIDE-COATED FISSILE PARTICLES. Shefcik, J. J. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 15, 1968. Contract AT(04-3)-167. 22p. Dep. CFSTI.

Conceptual flowsheets and costs were developed in this study for the addition of fissile-particle reprocessing capability to a central HTGR fuel reprocessing plant sized to serve a 15,000-MW(e) HTGR economy. The SiC-coated fissile particles, isolated during the screening step in the burn-leach head-end process, are routed to a grind-burn-leach auxiliary head-end process for conversion to a solvent-extraction feed solution. A two-cycle solvent-extraction system followed by a silica-gel tail-end treatment decontaminates and purifies the fissile-particle uranium. Additional equipment is needed for the grind-burn-leach and fissile uranium decontamination operations. Radioactive wastes arising from fissile uranium processing are combined with those from the main-line (fertile uranium) process for solidification and disposal. The estimated costs associated with the HTGR fuel reprocessing plants both with and without fissile uranium recovery capability are given. The incremental cost of processing the fissile particles from irradiated fuel is an estimated $0.50/g of fissile-particle uranium. (auth)

2371 (GAMD–8661) HTGR FUEL REPROCESSING: EFFECTS OF INCLUDING A SILICON CARBIDE COATING ON FERTILE FUEL PARTICLES. Shefcik, J. J. (Gulf General Atomic, Inc., San Diego, Calif.). May 10, 1968. Contract AT(04-3)-167. 16p. Dep. CFSTI.

Conceptual flow sheets and reprocessing costs were developed for recovery of thorium and uranium from HTGR fuel elements containing silicon carbide-coated fissile and fertile particles. Two cases were considered. In Case IIIB the fertile particles were processed, and the fissile particles isolated, packaged, and stored for eventual disposal or future processing. In Case IIIB1, both types of particles are processed to recover the contained uranium. Flow sheets and costs were derived from those contained in an earlier study where only the fissile particles had a silicon carbide coating. A modified burn-leach head-end process is used to prepare the fuel components for separation and decontamination by solvent extraction. The estimated costs associated with the two cases are listed. The reprocessing charges given assume plant operation at its design capacity. No credit is included for the recovered thorium or fissile particle uranium. The incremental cost of recovery of the fissile particle uranium is $0.45/g. (auth)

2372 (IN–1224) A HIGHLY EFFICIENT INORGANIC ADSORBER FOR AIRBORNE IODINE SPECIES (SILVER ZEOLITE DEVELOPMENT STUDIES). Maeck, W. J.; Pence, D. T.; Keller, J. H. (Idaho Nuclear Corp., Idaho Falls). Oct. 1968. Contract AT(10-1)-1230. 19p. Dep. CFSTI.

A synthetic zeolite, Linde Molecular Sieve 13X, converted to the silver form strongly adsorbs inorganic and organic species of airborne iodine. As a filter material for the cleanup of iodine from reactor containment atmospheres, it has ideal properties of nonflammability, high-temperature operability with adsorption of iodine up to 500°C, retention of iodine up to 1000°C, and a rapid reaction time. Retentions of greater than 99.98% were measured for elemental iodine and for methyl iodide for a variety of conditions varying from dry flows at room temperature, dry flows at 500°C, and steam-air mixtures. Other promising applications of this type of material to the nuclear industry include cleanup of dissolver off-gas from chemical processing plant operations, filter materials for health physics safety devices such as face masks and air monitors, and adsorbing filters in sampling devices. (auth)

2373 (KFK–766) SYNERGISTIC EFFECT IN THE EXTRACTION OF YTTRIUM AND AMERICIUM WITH KETONE. Schweizer, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). July 1968. 67p. (In German). Dep.

In the comparison of the extraction of Am(III) and Y(III) by substituted 1,2- and 1,3-diketones in chloroform and methyl isobutyl ketone (hexone) as the organic phase, a preferential extraction in hexone was established. This phenomenon was explained as a synergistic effect. A synergistic effect could also be established in methyl butyl ketone, methyl tert-butyl ketone, diisobutyl ketone, and butylcyclohexanone. The extraction of Am(III) and Y(III) with 1,2- and 1,3-diketones can be expressed by the relation $Me^{3+} + 3L^- \rightarrow (MeL_3)_w \rightleftharpoons (MeL_3)_0$. The yttrium chelates are more stable than the Am chelates. The $pH_{\frac{1}{2}}$ value of the Y is 0.13 to 0.40 units lower than that of Am. In the same chelating agent and the same organic phase, YL_3 has a higher distribution coefficient than AmL_3. The synergistic effect in the extraction of ML_3 in monoketones (A) as the organic phase was carried out by the formation of adduct chelates. The stability constants of these adducts were calculated with the help of a graphic method. The Y adduct chelates are more stable than those of Am. The effect of the structure of the monoketone on the stability of the adduct is much greater in the case of Y than in the case of Am. With increasing branching of the butyl residue of methyl butyl ketone, the stability of the adduct decreases. This is attributed to a steric hindrance. The adduct chelates of $ML_3 \cdot A$ and $ML_3 \cdot 2A$ with monoketones have a much lower stability than the corresponding adducts with phosphorus-containing components. (tr-auth)

2374 (LA-DC–10005) TREATMENT OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE CONCENTRATES. Christenson, C. W. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 63p. Dep. CFSTI.

From Basic Training Course in Management of Radioactive Wastes, IAEA–Brazil CNEN, Rio de Janeiro, Oct. 14–25, 1968. radioactive wastes 18G

Generally accepted methods for handling and processing concentrates from low- and intermediate-level wastes are described. These methods include: solar evaporation; filtration (gravity, pressure, and vacuum); centrifugation; incorporation into bitumen or asphalt; and incorporation into cement and vermiculite. Installations and results are also described for the various methods. (P.C.H.)

2375 (LA-DC–10007) CHEMICAL TREATMENT OF LIQUIDS. Christenson, C. W. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 33p. Dep. CFSTI.

From Basic Training Course in Management of Radioactive Wastes, IAEA–Brazil CNEN, Rio de Janeiro, Oct. 14–25, 1968.

Coagulation, flocculation, and sedimentation methods for the treatment of low-level radioactive liquid wastes are described. Specific precipitation methods for removal of Ru, Cs, and Sr are discussed. (P.C.H.)

2376 (NP–17614) SEPARATION OF TRANSPLUTONIUM ELEMENTS FROM IRRADIATED PLUTONIUM. I. EQUIPMENT. Berger, R.; Baudet, M.; Gradaive, J.; Hecq, R. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). Feb. 1964. 72p. (In French). Dep.

A general description is given of the chain of hot cells M 7 SMTI and the modifications made to them in preparation for the

chemical processing of a highly irradiated Pu–Al fuel element. The interior equipment and the specialized accessories necessary for its operation are also described. This analytical chain originally designed to handle about 10 Ci of γ radiation per cell was adapted to sources of the order of 50 Ci by reinforcing the biological protection on the top and front sides. Because of the versatility and interchangeability of the apparatus, it is always possible to repair mechanical accidents, particularly those on the manipulators. After a year in service, two chemical processings were carried out without decontamination or shutdown. (tr-auth)

2377 (NP–17640) ACCURACY OF URANIUM ACCOUNTING IN THE EUROCHEMIC REPROCESSING PLANT. Frenzel, W. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Apr. 1968. 17p. (ETR–212). Dep.

A study of the accuracy of uranium accounting was made on the basis of the corrections in uranium accounts during the first slightly enriched fuel reprocessing campaign at EUROCHEMIC. Basic figures, which indicate the number of accounted transfers, the type of transfers, the number of physical inventories, and the limitations of this group, are given. The accounting system is described and the actual accounting data are reported in the form of processing balances. Also given are error estimates for measurements of the different material streams. There is a balance for each of the three main Material Balance Areas, as well as one that combines these three. It was found that all but one of the shipper-receiver differences are within the estimated limit of standard error. The overall B-PID per campaign can rise up to about ±1.0% of the input to the plant plus the quantity measured as physical inventory at the beginning of the considered period. (auth)

2378 (ORNL–4224) FLUORINATION OF FALLING DROPLETS OF MOLTEN FLUORIDE SALT AS A MEANS OF RECOVERING URANIUM AND PLUTONIUM. Mailen, J. C.; Cathers, G. I. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 21p. Dep. CFSTI.

A falling-drop fluorination method was devised for the recovery of uranium and plutonium from molten fluoride salts. This method, in which molten-fluoride droplets fall countercurrently through fluorine, has several advantages over methods in which fluorine is bubbled through the molten salt. Among these are: (1) higher removal rates for both uranium and plutonium, (2) lower rates of corrosion of the containment vessel (since the molten salt does not contact the wall), (3) the possibility of continuous operation, and (4) minimal corrosion-product contamination of the fluorinated salt. The low corrosion-product content and longer fluorinator life are especially attractive from the standpoint of molten-salt reactor processing, where the fluorinated salt must be recycled to the reactor and the fluorinator must be very durable. Experimental equipment was developed, and small-scale fluorination experiments were made, using several salt solutions. With the data obtained from these experiments, we calculated that, by using a 5-ft-long fluorination column at 650°C, 99.9% of the uranium can be removed from 100-μ-diam droplets of Molten-Salt Breeder Reactor fuel. With an 11-ft-long tower at 640°C, 99% of the plutonium can be removed from 100-μ-diam droplets of salt. In similar experiments using salt droplets containing ^{231}Pa, no protactinium was fluorinated, even at temperatures as high as 614°C. (auth)

2379 (ORNL-TM–2213) DESIGN OF AN ENGINEERING-SCALE, VACUUM DISTILLATION EXPERIMENT FOR MOLTEN-SALT REACTOR FUEL. Carter, W. L.; Lindauer, R. B.; McNeese, L. E. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 133p. Dep. CFSTI.

Experimental equipment was designed for an engineering-scale demonstration of vacuum distillation of molten-salt reactor fuel. The distillation is carried out at about 1000°C and 1 mm Hg to separate LiF–BeF_2 carrier salt from less volatile fission products, primarily the rare earths. Uranium tetrafluoride is not present during the distillation. The experiment is designed for continuously feeding a molten salt–fission product mixture into a still at the same rate that distillate is being removed, thereby concentrating fission products in the still. Also, the still may be operated batch-wise to give large concentration factors. Frequent sampling of the distillate furnishes data on the separation between carrier and fission products as a function of concentration in the still bottoms. The equipment consists of a 48-liter feed tank, a 12-liter still, a 10-in. diam × 51-in. condenser, a 48-liter condensate receiver, plus associated temperature, pressure, and level control instrumentation. All vessels and parts contacted by molten salt are made of Hastelloy N. The unit is electrically heated by shell-type, ceramic heaters. About 90% of the experimental program will be devoted to nonradioactive operation using mixtures of LiF, BeF_2, ZrF_4, and selected rare earth fluorides. The experiment will be concluded by distilling a 48-liter batch of uranium-free spent fuel from the Molten-Salt Reactor Experiment. (auth)

2380 (ORNL-tr–2013) RAPID SEPARATION OF RADIOACTIVE ELEMENTS BY VACUUM EVAPORATION. Gasior, Marian; Lizurej, Henryk I.; Niewyrodniczanski, Henryk; Potema, Antoni W. (Institute of Nuclear Research, Krakow (Poland)). Translated for Oak Ridge National Lab., Tenn., from report INP–584/PL. 8p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 23096.

2381 (RT/CHI–(68)11) EXTRACTION PILOT PLANT FROM FLOWSHEET EXPERIENCE WITH PLUTONIUM. Abita, M.; Baldini, E.; Piana, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 17p. (In Italian). Dep.

In order to verify the Eurex flowsheet and to observe experimentally the effective decontamination of uranium from plutonium, a pilot-scale reprocessing extraction was set up in a glove box. The general design and characteristics of the extraction installation are described in detail and illustrated. (J.S.R.)

2382 (SZS–10/68, pp 18–42) DECONTAMINATION OF LIQUID RADIOACTIVE WASTES BY CONTACT PRECIPITATION: ECONOMIC ANALYSIS FOR BUILDING AND OPERATING DECONTAMINATION PLANT WHICH COMBINES CONTACT PRECIPITATION AND ION EXCHANGE PROCESSES. Sachse, G.; Haentzschel, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). (In German).

On the basis of investigations on the decontamination of radioactive wastes by contact precipitation and ion exchangers in a pilot plant scale a calculation of costs was carried out for the building and operation of a plant with a capacity of 10 m^3/hr. Considering this the investment costs are 290,000 marks and 320,000 marks for a plant with ion exchange and a preceding softening by a one-stage and a two-stage contact precipitation, respectively. The operation costs for the contact precipitation step are 0.99 marks/m^3 and 0.94 marks/m^3 for the one-stage and the two-stage operation, respectively. Using the ion exchangers in the NaCl form the total operation costs are 2.45 marks/m^3, whereas they are 2.86 marks/m^3 when the exchangers are used in the H–OH form. (auth)

2383 REMOVAL OF ^{90}Sr FROM MILK BY ISOTOPIC EXCHANGE. (to United States Atomic Energy Commission). British Patent 1,132,566. Nov. 6, 1968. Priority date Dec. 23, 1966, United States.

A method is described for the purification of milk by removing radioactive ^{90}Sr by isotopic exchange. The method consists of contacting the milk with an inorganic salt selected from the group consisting of strontium pyrophosphate and calcium pyrophosphate and mixtures thereof. The inorganic salts are attached to a porous silica–alumina support, thereby removing the radioactive strontium from the milk. (P.C.H.)

2384 D_2O FROM SYNTHESIS GAS LOOKS PROMISING. Can. Chem. Process., 52: 71-4(Sept. 1968).

Studies by AECL indicate that auxiliary units attached to ammonia plant could produce low cost heavy water. While the process appears feasible some uncertainties require more investigation. The economics of this and related isotopes exchange processes are examined. (F.S.A.)

2385 PLUTONIUM(IV) EXTRACTION FROM NITRIC ACID SOLUTIONS BY MIXTURES OF LONG-CHAIN AMMONIUM NITRATES. Bac, R. (Institutt for Atomenergi, Kjeller, Norway). Radiochim. Acta, 9: 130-9(Aug. 1968).

The liquid-liquid extraction of tracer amounts of Pu(IV) from 0.5 and 3M HNO_3 solutions by a mixture, A + B, of two quaternary ammonium nitrates of a high molecular weight, or of one such nitrate with a long-chain tertiary amine nitrate in chloroform and in octanol-containing solvents n-dodecane or o-xylene was studied. The Pu(IV) distribution coefficients D observed are not widely different from the values calculated for $D = (D_A^{1/q} + D_B^{1/q})^q$ where D_A and D_B represent the Pu(IV) distribution coefficients for each of the components alone, and q denotes the slope value of the extraction curve, log D_A vs log $[A]_{initial}$. The extracting agents used are: trilaurylamine (TLA), trilaurylmethylammonium nitrate (TLMA), and hexadecyldimethylbenzylammonium nitrate (HDDMBA). Thermodifferential molecular weight determinations of quaternary ammonium nitrates and their Th(IV) and U(VI) nitrate complexes in benzene showed a higher degree of association for the metal complexes than for the extracting agents. By saturation of solutions of different quaternary ammonium nitrates in benzene with $Th(NO_3)_4 \cdot 6\ H_2O$ the thorium loading is lower in both the light and heavy organic phases than would correspond with a ratio of two

quaternary ammonium nitrate molecules to one thorium atom. (auth)

2386 DECONTAMINATION OF RADIOACTIVE RESIDUES BY MEANS OF ION EXCHANGE. de Lora Soria, F.; Yee, W. C. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 475-82 (May 1968). (In Spanish).

A process for the decontamination of low level radioactivity wastes by coagulation-clarification using activated carbon sorption and ion exchange is described. The effluent of the process is decontaminated and demineralized water which can be reused. The radioisotopes studied were: Ce-144, Ru-106, Cs-137, Zr-95–Nb-95, Sb-125, Co-60, I-131, Sr-90 and total rare earths. The total decontamination factors range from 100 to 10,000. (auth)

2387 GAS CHROMATOGRAPHY OF SOME METAL CHELATES OF BENZOYLTRIFLUOROACETONE AND THENOYLTRIFLUOROACETONE AND OF THE COMPLEXES OF THE RARE EARTHS WITH THE MIXED LIGANDS HEXAFLUOROACETYLACETONE AND TRI-N-BUTYLPHOSPHATE. Butts, William Cunningham. Ames, Iowa, Iowa State Univ., 1968. 110p.

Thesis.

The copper, aluminum, gallium, chromium, and iron chelates of benzoyltrifluoroacetone (HBTA) and of thenoyltrifluoroacetone (HTTA) can be gas chromatographed in the temperature range of 160 to 280°C. The chelates of HBTA were found to be significantly more volatile than those of HTTA. Gas chromatographic separations of several of the chelates of HBTA were obtained. Chemical analysis of the chelates prior to chromatographing and comparison of the ultraviolet spectra of the eluted species and of the original chelates confirmed that the chelates passed through the gas chromatographic column intact. Chromatograms were obtained for $Cr(BTA)_3$ over the concentration range 6×10^{-4} to 4×10^{-2} molar. The mixed-ligand complexes of the rare earths with hexafluoroacetylacetone (HHFA) and tri-n-butylphosphate (TBP) can also be gas chromatographed. Column temperatures as low as 125°C were used for the more volatile complexes. The order of elution of these mixed-ligand complexes of the rare earths was in the same order as the increasing radii of the trivalent rare earths. Gas chromatographic separations of several rare earth complexes were obtained. The eluted species were identified as being of the form $M(HFA)_3 \cdot 2\,TBP$, where M represents the trivalent rare earth. Identification was based principally on the infrared spectra of the ligands and complexes. A solvent extraction-molar ratio study of the HHFA and TBP mixed-ligand extraction of the rare earths indicated the extracted species also to be $M(HFA)_3 \cdot 2TBP$. All of the complexes chromatographed were prepared by solvent extraction, and the samples were taken directly from the organic phase. One hundred per cent extraction was obtained with equilibration times of less than 15 minutes and at pH values as low as pH 2. (Disser. Abstr.)

2388 BASIC STUDIES ON THE TREATMENT OF FUEL-REPROCESSING LIQUID WASTES BY THE FLOTATION METHOD. VII. SELECTIVE REMOVAL OF MIXED FISSION PRODUCTS. Mukai, Shigeru (Kyoto Univ.); Koyanaka, Yoshio. Nippon Kogyo Kaishi, 84: 341-2(Mar. 1968). (In Japanese).

Basic studies were carried out on the selective removal of groups of fission products from liquid wastes. ^{137}Cs, ^{90}Sr, ^{144}Ce, ^{106}Ru and ^{95}Zr were grouped on the basis of results previously obtained by the flotation method. The experiments were made with imitated liquid wastes, and the feasibility of such removal by the flotation method was clearly demonstrated. Although further investigation needs to be made on how it works in practice, the procedure provides a clue to the development of a new treatment method for fuel reprocessing of liquid wastes. (auth)

2389 REVIEW OF THE LITERATURE OF 1966 ON WASTE WATER AND WATER-POLLUTION CONTROL. J. Water Pollut. Contr. Fed., 39: 867-945(1967).

The review covers wastes from food processing, chemical and pharmaceutical plants, coal mining and metal pickling and plating, pulp and paper wastes, and textile and tannery wastes. A section on radioactive wastes includes disposal and treatment, procedures for the determination of radioactive elements, stream-monitoring practices and tracer applications. (647 references.) (Anal. Abstr.)

2390 APPLICATION OF ION EXCHANGE TO THE DETERMINATION OF IONIUM (^{230}Th) IN ORES AND SOLUTIONS OF LOW URANIUM CONTENT. Palomares, J.; Travesi, A. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 755-64(July-Aug. 1968). (In Spanish).

A simple and very rapid method was developed for the determination of micro quantities of ionium in the order of 10^{-8} g or less, existing in minerals and solutions containing low concentrations of uranium. The use of the radioactive tracer of carrier-free ^{234}Th allows for the correction of the yield of the chemical separation. Yields higher than 90% of thorium can be obtained. (auth)

2391 RECTIFICATION OF HEAVY WATER IN COLUMNS IN PARALLEL. Gispert, M.; Rojas, J. L. (Junta de Energia Nuclear, Madrid). An. Quim., 64: 765-74(July-Aug. 1968). (In Spanish).

The results obtained in the rectification of heavy water by means of a system of two parallel columns 9 m high, and 10 cm of diameter and packed with Dixon rings of 3 mm (with a single still), are described. The setting-up, starting, and running characteristics were studied. The efficiency for several boiling rates, and the production of the system were tested in order to employ it in a heavy water production cascade. (auth)

2392 AN X-RAY STUDY OF STRONTIUM–SODIUM ION EXCHANGE IN LINDE X. AN EXAMPLE OF A TWO-PHASE ZEOLITE SYSTEM. Olson, David H.; Sherry, Howard S. (Mobil Research and Development Corp., Princeton, N. J.). J. Phys. Chem., 72: 4095-4104(Nov. 1968).

The unusual ion exchange behavior of this system is caused by a region of limited solubility of the end members NaX and SrX. In this region two zeolite phases are in equilibrium with each other, an aqueous solution and the vapor phase. The composition of all four phases is constant as long as they are in equilibrium with each other at constant temperature as demanded by the phase rule. Structural studies and lattice parameter measurements indicate that Sr^{2+} ion exchange of NaX causes a small lattice contraction. In the Sr-saturated zeolite crystals, Sr^{2+} ions partially occupy positions just outside hexagonal prisms in the sodalite cages and just outside of the hexagonal rings that separate the large cages from the sodalite cages (on the supercage side of these rings). The hexagonal prisms are almost completely occupied by Na^+ ions. In the new expanded zeolite crystals the major change in the structure is the almost complete absence of ions in the hexagonal prisms. It is believed that the movement of Sr^{2+} ions into the sodalite cages is responsible for the early lattice contraction and that the movement of Na^+ ions from the hexagonal prisms is responsible for the nucleation and growth of a new phase with an expanded lattice. (auth)

2393 EVAPORATION–CONCENTRATION OF SYNTHETIC HIGHLY-RADIOACTIVE WASTE SOLUTION BY SUBMERGED COMBUSTION. Iwamoto, Kazumi (Japan Atomic Energy Research Inst., Ibaraki). Radioisotopes (Tokyo), 17: 517-22(Nov. 1968). (In Japanese).

Evaporation and concentration of synthetic Purex 1WW waste solution by submerged combustion were experimentally studied. A mixture of propane and oxygen gases was used as a fuel gas to the quartz-made burner. The boiling point of still residue was 10 to 16°C lower than that in the ordinary evaporator, and volume reduction of the waste solution was performed until the volume reduction ratio (volume of still residue/volume of feed) reached 0.3. The submerged combustion evaporator having a small, simple structure operated successfully, and thermal efficiency was high. The volume of off-gas may be reduced if carbon dioxide in the flue gas is removed and the combustion in the burner proceeds completely. The solution containing aluminum nitrate was evaporated, and converted into solid after cooling the concentrate down to room temperature. (auth)

2394 THE ION-EXCHANGE PROPERTIES OF ZEOLITES. IV. ALKALINE EARTH ION EXCHANGE IN THE SYNTHETIC ZEOLITES LINDE X AND Y. Sherry, Howard S. (Mobil Research and Development Corp., Princeton, N. J.). J. Phys. Chem., 72: 4086-94(Nov. 1968).

The exchange of Ca^{2+}, Sr^{2+}, and Ba^{2+} ions for Na^+ ions has been studied in Linde X and Y. Replacement of 16 Na^+ ions per unit cell by Ca^{2+} and Ba^{2+} ions is slow in NaX. In the case of Ca^{2+} ions, this necessitates equilibration times of 1 week or longer. However, Ba^{2+} will not replace these cations at all at 25°. The replacement of 16 Na^+ ions by Ca^{2+}, Sr^{2+}, and Ba^{2+} ions is also slow in NaY. In the case of the latter zeolite, no exchange with these 16 cations takes place at 25°. The Na^+ ions that are difficult to replace are in the small cavities of these two zeolites. At 50°, Ba^{2+} ions do exchange with all the cations in all the cages of NaX. Measurement of the free energy of exchange of the Na^+ by Ba^{2+} ions in the large cages at low temperature and in all the cages at higher temperatures has permitted calculation of the individual equilibrium constants for the ion exchange of the networks of large and small cages. The selectivity data indicate no binding of Sr^{2+} and Ba^{2+} ions in the large cages of Linde Y and partial or complete binding in the other systems studied. The standard enthalpies and entropies of reaction indicate that most of these reactions are entropy

directed, and in the case of Ca^{2+} and Sr^{2+} ions the most important interactions are ion–water interactions in the solution phase. (auth)

2395 CESIUM SORPTION FROM LIQUID SODIUM. Cooper, M. H.; Taylor, G. R. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 525-6(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2396 FLUIDIZED-BED FLUORIDE VOLATILITY PROCESSING OF UO_2–PuO_2 FUELS WITH SIMULATED BURNUPS OF 10,000 AND 30,000 MWD/T. Anastasia, L. J.; Alfredson, P. G.; Steindler, M. J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 447(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2397 SALT TRANSPORT PROCESS FOR FAST BREEDER REACTOR FUELS. Steunenberg, R. K.; Johnson, I.; Pierce, R. D. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 447-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2398 SIMULTANEOUS CUTTING AND LIXIVIATION HEAD-END PROCESS STEP FOR SPENT NUCLEAR FUEL REPROCESSING PLANTS BY ELECTROLYTIC WAY. Van Impe, Jean (L'Electro-Navale and Industrielle, Antwerp); Rombaux, Jean-Pierre; Gilbaut, Fernand. Trans. Amer. Nucl. Soc., 11: 448 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2399 EXPLOITATION OF A CHAIN OF CHEMICAL CELLS PROPOSED FOR STUDYING THE REPROCESSING OF HIGHLY IRRADIATED FUELS. Miquel, Pierre (CEA, Fontenay-aux-Roses, France). Trans. Amer. Nucl. Soc., 11: 448-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2400 METHOD OF DISSOLVING ALUMINUM-CLAD THORIA TARGET ELEMENTS. Burns, R. E.; Phillips, J. F.; Schulz, W. W. (to United States Atomic Energy Commission). U. S. Patent 3,409,413. Nov. 5, 1968.

The dissolution of aluminum-clad thoria target elements used in the production of uranium-233 by irradiation in a nuclear reactor is described. The dissolving solution is 10 to 14 M nitric acid containing fluoride, mercury, and nickel ions. The fluoride and mercury ions together activate the aluminum so that it will dissolve in the concentrated HNO_3, the fluoride ion catalyzes the dissolution of the thoria, and the nickel ion controls the rate of dissolution of the aluminum. Gas generation produced by dissolution of the aluminum agitates the thoria and facilitates its dissolution. (AEC)

2401 EXTRACTION AND SEPARATION OF Ta, Nb, AND Ti BY MEANS OF FURFUROL. Chufarova, I. G.; Petunina, N. I. Zh. Prikl. Khim., 41: 2175-9(Oct. 1968). (In Russian).

Tantalum, niobium, and titanium extraction by furfurol was studied as a function of the hydrofluoric acid and metal concentrations in the solution. Optimum separation conditions were found and the composition of the hydrofluoric acid complexes with tantalum formed during extraction by furfurol were: HF : furfurol and $HTaF_6 \cdot 4$ furfurol, $H_2TaF_7 \cdot 4$ furfurol. (R.V.J.)

2402 EXTRACTION OF BERKELIUM VALUES IN THE TETRAVALENT STATE USING 2-THENOYLTRIFLUOROACETONE. Moore, F. L. (to United States Atomic Energy Commission). U. S. Patent 3,409,414. Nov. 5, 1968.

A method is described of selectively removing berkelium values from an aqueous solution. The pH of the solution is reduced to a value less than 2, the berkelium is oxidized to the tetravalent oxidation state, and the resulting berkelium values extracted with an organic solution of 2-thenoyltrifluoroacetone. (AEC)

2403 METHOD OF EXTRACTING SOLUBLE METAL COMPLEXES USING AMINE SOLVENTS. Moore, F. L. (to United States Atomic Energy Commission). U. S. Patent 3,409,415. Nov. 5, 1968.

A method is described for removing metal values such as trivalent actinides and lanthanides from an aqueous solution substantially free of sulfate. A water-soluble organic carboxylic acid is added to the aqueous solution to complex the metal values. The resulting aqueous phase is then contacted with an organic solution of a high-molecular-weight amine having 10 or more carbon atoms to extract a metal–organic acid–amine complex into the organic phase. (AEC)

2404 PROCESS FOR CONCENTRATING HEAVY WATER. Thayer, Victor R. (to United States Atomic Energy Commission). U. S. Patent 3,411,884. Nov. 19, 1968.

A process is described for concentrating heavy water by the exchange of the deuterium isotope between water and hydrogen sulfide in staged pairs of hot and cold isotope exchange towers. The water stream of the first stage is passed from feed through first stage cold and hot towers and disposed of. Water is recycled within the stages after the first. Recycle, countercurrent H_2S gas flow is established throughout all of the stages, a portion of the hydrogen sulfide flow of each stage except the last being cascaded to its subsequent stage. Water enriched in deuterium oxide is advanced from the first to higher stages by transport as humidity in the cascaded gas. (AEC)

2405 RECOVERY OF PLUTONIUM FROM REFRACTORY SILICEOUS MATERIALS. Conner, William V. (to United States Atomic Energy Commission). U. S. Patent 3,410,668. Nov. 12, 1968.

A method is described for recovering plutonium from siliceous material including grinding the material containing plutonium to a fine powder, leaching the powder in a boiling nitric acid solution, filtering and washing the residual powder, and recovering the plutonium from the filtrate. (AEC)

2406 RECENT STATE OF INVESTIGATIONS ON THE SEPARATION OF BORON ISOTOPES. Katal'nikov, S. G.; Nedevetskii, V. S.; Pisarev, V. E.; Voloshchuk, A. M. Isotopenpraxis, 4: 341-52(Sept. 1968). (In Russian).

The advantages and disadvantages of methods known so far for the separation of the boron isotopes are reviewed. Some problems arising at high pressures are also discussed. The BF_3 complexes are classified, and publications dealing with the exchange reactions between BF_3 and its liquid complexes are surveyed. All known reactions between BF_3, BCl_3 as well as other boron compounds and their complexes for which the separation coefficient α has been measured are listed. (113 references) (auth)

2407 SEPARATION OF RARE EARTHS FROM CERAMIC NUCLEAR FUELS BY SELECTIVE IODINATION. Amecke, B. (Technische Hochschule, Brunswick); Scherff, H. L. Radiochim. Acta, 9: 169-70(Aug. 1968). (In German).

A method for the separation of the oxides of the rare earths from uranium oxide is described. It is based on the iodination of rare earths up to Dy at temperatures below 1500°C, a temperature at which iodination of U and Th does not occur. Pure oxides of UO_2, ThO_2, La_2O_3, CeO_2, and Sm_2O_3 and a mixed oxide consisting of 90% UO_2 and 5% each of La_2O_3 and CeO_2 were investigated. The studies showed that at 1100° for a reaction time of 24 hrs in the presence of a carbon excess, uranium oxide and thorium oxide did not react with the iodine, but iodides of La, Ce, and Sm were formed. The iodide yield is proportional to the iodine partial pressure at pressures between 4 and 25 Torr. At low iodine pressures, the reaction to the iodide is velocity determined, but at higher pressures the reaction rate is determined by the diffusion of rare earths in the mixed oxide. (J.S.R.)

2408 NEW EXTRACTION CHROMATOGRAPHIC METHOD FOR RAPID SEPARATION OF AMERICIUM FROM OTHER TRANSURANIUM ELEMENTS. Moore, Fletcher L. (Oak Ridge National Lab., Tenn.). Anal. Chem., 40: 2130-3(Dec. 1968).

A simple, rapid method is described for the separation of americium from curium and other actinide elements. The method exploits a new oxidation technique for the preparation of americium(V) in dilute nitric acid solution with ammonium persulfate. Isolation of the americium is achieved by extraction chromatography with small Teflon columns containing di(2-ethylhexyl)-phosphoric acid as the stationary phase. The method considerably simplifies the purification and determination of ^{243}Am in the presence of high levels of ^{244}Cm. Several useful applications for both analytical and purification purposes are discussed. (auth)

2409 RECOVERY OF CERIUM AND LANTHANUM. Chem. Process. (London), 14: 16-19(Nov. 1968).

A process for the isolation of these rare earths from complex lanthanide solutions by a simple oxidation-precipitation process using ozone is described. (auth) (UK)

2410 LANTHANIDE DISTRIBUTION COEFFICIENTS ON DOWEX CHELATING RESIN A-1. Schrobilgen, G. J.; Lang, C. E. (Loras Coll., Dubuque, Iowa). J. Inorg. Nucl. Chem., 30: 3127-30(Nov. 1968).

The results obtained are in agreement with a previously observed elution sequence for La^{3+} and Lu^{3+} on Dowex A-1 chelating resin. At 25.00°C, pH 2.00 and μ = 0.100 (NaCl), the selectivity of the resin for trivalent lanthanide ions was shown to be La^{3+} <

$Pr^{3+} < Nd^{3+} > Sm^{3+} > Gd^{3+} > Tb^{3+} \sim Dy^{3+} < Er^{3+} > Yb^{3+}$. Anomalies in selectivity appear to arise from a positive increase in the electrical contribution to ΔG. Such an increase may be associated with the phase change $Ln^{3+}_{aqueous} \rightarrow Ln^{3+}_{resin}$. When the observed distribution coefficients were corrected for this effect, rather good agreement was obtained between the lanthanide-Dowex A-1 and the simpler monomeric chelate stability trends. (auth) (UK)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 2430, 2681, and 2685.

2411 (AEC-tr-6968) ^{239}Pu IN NATURE. Cherdyntsev, V. V.; Zverev, V. L.; Kuptsov, V. M.; Kislitsina, G. I. Translated for Savannah River Lab., Aiken, S. C., from Geokhimiya, No. 4, 395-401(1968). 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 25516. (R.C.K.)

2412 (SZS-10/68) ECONOMICS OF THE COLLECTION, TREATMENT, AND DISPOSAL OF RADIOACTIVE WASTES IN THE G.D.R. COST OF BUILDING AND OPERATING RADIOACTIVE WASTE DECONTAMINATION PLANT WHICH COMBINES CONTACT PRECIPITATION AND ION EXCHANGE PROCESSES. Dagen, A.; Alm, M.; Sachse, G.; Haentzsche., H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1968. 42p. (In German). Dep.

Two papers on the cost of processes used in East Germany for the treatment of liquid radioactive wastes are presented. A separate abstract was prepared for each. (L.C.L.)

For abstracts of individual sections see: 2382 and 2413.

2413 (SZS-10/68, pp 1-17) ECONOMICS OF THE COLLECTION, TREATMENT, AND DISPOSAL OF RADIOACTIVE WASTES IN THE G.D.R. Dagen, A.; Alm, M. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). (In German).

In the G. D. R. (East Germany), solid and liquid radioactive wastes are collected and treated in a pilot plant by distillation, precipitation, ion exchange or baling. The resulting concentrates are packed in 200-l steel drums and stored in mine galleries. The parameters of the pilot plant as well as the treated wastes are described. In order to estimate the total costs of the disposal of the different wastes, a cost evaluation was performed of the single processes (collection, treatment, and disposal). The total costs per unit volume of waste are presented for the several kinds of waste. (auth)

2414 CONCENTRATION CHANGES OF Ca, Cu, Li, Mg, K, Na, AND Sr IN THE HUDSON RIVER, NEW YORK. Fabricand, Burton P.; Imbimbo, Eugene S.; Brey, Mary E. (Hudson Labs. of Columbia Univ., Dobbs Ferry, N. Y.). J. Sediment. Petrol., 38: 671-4(June 1968).

The concentrations of Ca, Cu, Li, Mg, K, Na, and Sr at various points in the Hudson River and one of its tributaries during July 1965, were measured along with the conductivity of the water. Levels of Ca, Mg, K, Na, and Sr all showed a minimum about 130 km from the mouth of the river, as did conductivity. The cleanup process necessary to account for this minimum may sharply reduce the contribution of dissolved ions to the ocean. Concentration values in ppM, averaged over samples taken from 3 points upstream from the minimum, were as follows: Ca, 24.5; Cu, 0.01; Mg, 6.7; K, 1.2; Na, 15.7; Sr, 0.14. There was a large contribution to these elements from ocean waters at least as far as West Point, New York, 90 km from the river mouth. Upper limits on the concentrations of Cr, Co, Fe, Pb, Li, Mn, Ni, and Rb were established. (BBB)

2415 NEW NUCLEAR LOGGING METHODS. Rybach, L. (Swiss Federal Inst. of Tech., Zurich); Youmans, A. H. Bull. Ver. Schweiz. Petrol.-Geol.-Ing., 35: 34-51(Mar. 1968).

New logging methods employing γ and neutron radiation which have been applied in petroleum exploration are reviewed. The construction of miniaturized accelerators as neutron sources, which will fit into casings and can operate even at extreme borehole conditions, initiated the development of many new types of log. The neutron lifetime log is used to determine water saturation and to locate water/oil and oil/gas boundaries behind casings and to monitor reservoir parameter changes. The oxygen log can distinguish oil from water in the rock pores, and the silicon log is of valuable assistance for lithologic studies. Presence and quantity of chlorine in porous zones can be determined by the chlorine log. The flowing neutron log indicates zones of gas entry, while the epithermal neutron log gives an improved estimate of the hydrogen content of formations. The dual spaced density log measures formation bulk density corrected for the effect of mud cake and borehole roughness. Operating principles and field examples are described. It is concluded that nuclear logs offer the best prospect for finding cased-off oil. The greatest prospect for significant improvements in nuclear logs appears to lie in the use of the neutron generator along with more refined techniques for spectral analysis of γ-ray and neutron energies. The neutron lifetime log has proven the electromechanical neutron generator to be practical for field use. (BBB)

2416 CALIBRATION OF THE RADIOCARBON TIME SCALE. Walton, A.; Baxter, M. S. (Univ. of Glasgow). Nature (London), 220: 475-6(Nov. 2, 1968).

The application of "correction factors" to radiocarbon ages is discussed, particularly in the light of discrepancies observed in existing data, and the uncertainties which obtain. A particular application discussed is concerned with tree ring data. (UK)

2417 RADIOACTIVE CONTAMINATION OF WATER: A NEW APPROACH NEEDED. Amavis, Rene; Smeets, Jan. Euratom Rev., 7: 67-73(Sept. 1968).

Radioactive contamination of water is discussed with a review of sources of radioactive contamination, both accidental and intentional, the behavior of radioisotopes in the hydrosphere, and the hazards to public health from such contamination. The research activities of the Commission of the European Communities for investigating, evaluating, and controlling radioactive contamination of water are outlined, and further international cooperation in these endeavors is recommended. (L.C.L.)

2418 MEASUREMENTS OF THORON FLUX EMANATED FROM THE GROUND AND VERTICAL REPARTITION OF RADON AND THORON AT VARIOUS LEVELS ABOVE GROUND. Blanc, Daniel; Druilhet, Aime; Fontan, Jacques; Guedalia, Daniel; Laurent, Jean-Louis (Centre de Physique Atomique et Nucleaire, Toulouse). Geofis. Meteorol. (Genoa), 17: 99-105(May-Aug. 1968). (In French).

In order to study the atmospheric diffusion in the boundary layer (between 0 and 100 meters), natural radioactive gases (radon and thoron) and their daughters were used. The experiments were carried out at the site of the future airport Paris-Nord. The air samplings were taken at several levels along a 100 meter-high tower. The principle of the measurement methods is set forth, and the experimental apparatus is described. For these measurements it is important to know the quantities of thoron and of radon which emanate from the ground. In the case of thoron it suffices to know the flux leaving the ground on an area of several hundred square meters around a point where the vertical-repartition measurements are carried out. A new method which allows for the direct measurement of the value on an area of 0.2 m^2 is introduced; measurement takes only ten minutes. The experimental results obtained concerning the emanation of thoron from the ground are given along with the variations of the concentrations of radon and of thoron with altitude. (auth)

2419 URANIUM DISEQUILIBRIUM IN GROUNDWATER: AN ISOTOPE DILUTION APPROACH IN HYDROLOGIC INVESTIGATIONS. Osmond, J. K.; Rydell, H. S.; Kaufman, M. I. (Florida State Univ., Tallahassee). Science, 162: 997-9(Nov. 29, 1968).

The distribution and environmental disequilibrium patterns of naturally occurring uranium isotopes ^{234}U and ^{238}U in waters of the Floridan aquifer suggest that variations in the ratios of isotopic activity and concentrations can be used quantitatively to evaluate mixing proportions of waters from differing sources. Uranium is probably unique in its potential for this approach, which seems to have general usefulness in hydrologic investigations. (auth)

2420 DETERMINATION OF THE RATE OF SNOW ACCUMULATION AT THE POLE OF RELATIVE INACCESSIBILITY, EASTERN ANTARCTICA: A COMPARISON OF GLACIOLOGICAL AND ISOTOPIC METHODS. Picciotto, E. (Ohio State Univ., Columbus); Cameron, R.; Crozaz, G.; Deutsch, S.; Wilgain, S. J. Glaciol., 7: 273-87(June 1968).

The rate of snow accumulation was measured at the U.S.S.R. station situated at the Pole of Relative Inaccessibility (eastern Antarctic plateau). Five independent methods were used. The results, expressed in g cm^{-2} $year^{-1}$, are as follows: accumulation-stake measurements show an accumulation of 3.1 ± 0.5 in 1965. A maximum value of 3.6 for the 6-year interval 1959 to 65 is derived from snow-thickness measurements; firn stratigraphy was found difficult to interpret in terms of annual layers. An upper limit of 12 g cm^{-2} $year^{-1}$ is suggested; $^{18}O/^{16}O$ ratios were measured along the upper 235 cm. Assuming that each maximum in the isotope profile corresponds to a summer season, the accumulation would be 8.6 ± 0.9; gross β radioactivity as a function of depth was measured on three firn sections. The 1955 radioactive fallout horizon is clearly marked, enabling the derivation of an average accumulation of 3.0 ± 0.1; and the average

accumulation over the last 80 years, derived from the ^{210}Pb distribution with depth, is 3.1 ± 0.3. A multi-annual average accumulation rate of (3.0 ± 0.3) was thus firmly established, as well as the validity of both the ^{210}Pb method and the 1955 radioactive fallout horizon method. Stratigraphic studies lead to uncertain results. Oxygen isotope variations give accumulation values which are too high by a factor of two at least. Accumulation values of the same order of magnitude (2.8 ± 0.2) were derived from radioactive fallout measurements at the U.S. "Plateau" station. (auth)

Meteorology

Refer also to abstracts 2217, 2524, and 2844.

2421 (AHSB(S)R–157) EFFECT OF DEPOSITION ON THE CONCENTRATION OF WINDBORNE MATERIAL. Brook, A. J. (United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch). 1968. 37p. Dep. CFSTI. UK.

The results of calculations which were made on the effect of deposition from clouds of windborne material are presented. The calculations indicate that neglect of this phenomenon may, in certain circumstances, result in appreciable over-estimation of the concentration of material in the cloud. A range of deposition velocities and effective release heights have been considered for the major classes of weather conditions. (auth)

2422 (NSJ-tr–132) DEPOSITION OF RADIOACTIVE FALLOUT OF 4th COMMUNIST CHINESE NUCLEAR TEST CARRIED BY GUIDED MISSILE IN NIIGATA. Takizawa, Yukio; Sugai, Ryuichi; Kosaka, Takao; Kubota, Teruo; Hattori, Hiroshi; Isawa, Masahiro; Ogata, Shoji. Translated from Niigata Igakkai Zasshi, 81: 75-9(1967). 14p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 10382. (R.C.K.)

2423 (TID–24762) CLIMATOLOGICAL DATA NEVADA TEST SITE AND NUCLEAR ROCKET DEVELOPMENT STATION. Quiring, Ralph F. (Environmental Science Services Administration, Las Vegas, Nev. Air Resources Lab.). Aug. 1968. 177p. (ERLTM-ARL–7). Dep. CFSTI.

Climatological data for the Nevada Test Site and Nuclear Rocket Development Station were compiled. The data and analyses are presented as samples from substantially different topographic environments to show the salient features of the seasonal and diurnal variations of wind and temperature near ground level and aloft. An evaluation of precipitation data for a 20-station network on the test site and a 5-yr climatological summary for the continuously manned Yucca weather station are included. (auth)

2424 CHARGE EQUILIBRIUM OF THE ATMOSPHERIC AEROSOL PARTICLES. Sekikawa, Toshio; Fujiwara, Hiroshi (Science Univ. of Tokyo). Nippon Genshiryoku Gakkaishi, 10: 554-60(1968). (In Japanese).

The ratio of concentration between charged aerosol particles and the total concentration in the atmosphere is changeable. This might be partly due to the fact that aerosols under natural condition are seldom in charge equilibrium state. The diurnal variation of the extent of disequilibrium in the natural state was measured. The diurnal variation of the extent of disequilibrium in the natural state was measured. The above-mentioned ratios of concentration were measured in aerosols under natural conditions and also in those sampled simultaneously but brought artificially to equilibrium by means of irradiation with ^{210}Po. (auth)

2425 TRANSPORT OF GASES TO AND FROM SURFACES WITH BLUFF AND WAVE-LIKE ROUGHNESS ELEMENTS. Chamberlain, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Quart. J. Roy. Meteorol. Soc., 94: 318-32 (July 1968).

Wind tunnel experiments were made on the transport of a radioactive vapor of thorium B, and water vapor, to and from surfaces with spherical, cylindrical and wavelike roughness elements. The results are analyzed in terms of the dimensionless number B of Owen and Thomson (J. Fluid Mech., 15: 321-34 (1963)). For values of the roughness parameter $u_* z_0 \nu^{-1}$ between 10 and 1,000 the results were found to conform approximately to Owen and Thomson's empirical formula $B^{-1} = \alpha (u_* h/\nu)^m (\nu/D)^n$ where h (= 30 z_0) is the equivalent sand roughness, D the diffusivity of the vapor, and α, m and n are constants with values 0.5, 0.45, and 0.8 respectively. Experiments with aerodynamically smooth surfaces gave results in accordance with von Kármán's equation. Wind profiles over large bodies of water imply rather small values of the roughness length and $u_* z_0 \nu^{-1}$ generally lies in the range 0.1 to 10. In this region the bluff-body effect on momentum transport is small, and is counteracted by the fact that D for water vapor is greater than ν. As a result B^{-1} is small, and the resistances to transport of momentum and water vapor are nearly the same. Experiments on the rate of evaporation of water in a tank in the wind tunnel gave values of the bulk evaporation coefficient, referred to a height 5 cm above the surface, in good agreement with theory. (auth)

2426 DETERMINATION OF THE PARAMETERS OF TURBULENT DIFFUSION USING THE VERTICAL DISTRIBUTION OF Tn AND ThB NEAR THE GROUND. Bakulin, V. N.; Sen'ko, E. E. (Kirov Teachers Inst., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz. Atmos. Okeana, 4: 1060-9(Oct. 1968). (In Russian).

The results of 15 daily measurements of Tn and ThB concentrations at 1 and 5 meters are compared with theoretical distributions of Tn and ThB using a different hypothesis about the vertical profile of turbulent diffusion coefficient. The daily variations of the turbulent parameter and of the turbulent diffusion coefficient are determined. (tr-auth)

2427 THE MEASUREMENT OF THE ATTACHMENT COEFFICIENTS OF THE NEUTRAL AND CHARGED RADON DECAY PRODUCTS ON AEROSOLS. Porstendoerfer, J. (Justus Liebig-Univ., Giessen, Ger.). Z. Phys., 217: 136-49(1968). (In German).

The attachment of the neutral and charged ^{212}Pb atoms to monodisperse polystyene latex aerosols with diameters 10^{-5} to 2×10^{-4} cm was measured and compared with the theoretical values. The method of measurement allowed the determination of the difference between the attachment coefficients of the ions and neutral atoms. The values obtained are explained with the diffusion model by considering the electrostatic forces between the diffusing ions and the aerosol particles. The best agreement of the measured attachment coefficients with those of theory is obtained if the image forces of the ^{212}Pb ions (dried latex areosols) are neglected in the computations. (auth)

2428 SIMPLIFIED TECHNIQUE FOR STACK DISPERSION MAPPING WITH TRITIUM. Gabay, J. J.; Sax, N. I. (Radiological Sciences Lab., Albany). Environ. Res., 2: 72-6(Sept. 1968).

A technique for wide-area stack effluent dispersion mapping is described using tritiated water as a tracer. The sampler consists of indicating silica-gel in a fiber-glass-screen bag conveniently placed in the field along sampling legs radiating out from the source. The adsorbed water vapor is removed from the silica gel by vacuum distillation and the tritium content determined by liquid scintillation counting. This technique has been used successfully to distances 10 miles from a source to experimentally determine the C_{max} of a stack effluent from a nuclear fuels reprocessing plant which already contained some tritiated water. This concept should find much use in pinpointing sources of specific contamination in urban, suburban and rural areas under a wide variety of meteorological conditions. (auth)

Mineralogy and Exploration

2429 (AEC-tr–6997) MORPHOLOGY OF URANIUM–MOLYBDENUM ORE BODIES. Storozhenko, S. A.; Konovalov, I. M. Translated from Geol. Rud. Mestorozhd., 9: No. 1, 88-91(1967). 8p. Dep. CFSTI.

An investigation was made to determine the structural zoning of molybdenum–uranium ore bodies found close to the surface. One ore deposit was studied. The composition of the effusive–sedimentary strata and of the ore-enclosing rocks was defined. The location and structure of faults and fissures in the area were measured. It was concluded that the structural zoning of molybdenum ore deposits is defined by the morphology of the mineralizing faults and by the materials in the surrounding fissures. (L.C.L.)

2430 NEW METHOD FOR ESTABLISHING RADIOACTIVE ORE-BODY LIMITS BASED ON RADIOACTIVITY MEASUREMENTS. Lungu, A. Stud. Cercet. Geol., Geofiz., Geogr., Ser. Geofiz., 5: 271-9(1967). (In Rumanian).

Methods for determining the thickness of a radioactive layer are reviewed. The physical and mathematical implications of gamma-ray intensity, due to sources uniformly dispersed into a bidimensional plan-parallel formation, are discussed. The peculiarities of the formula for gamma-ray intensity when measured near the active layer and the bounding formations (screens) are also established. The log of the intensity is considered. Layer limits are determined by means of linear segments plotted on the gamma-ray intensity log curve. The proposed method, as compared to other methods, affords a better determination and excludes subjectivity. (Rom. Sci. Abstr.)

Oceanography

2431 URANIUM CONTENT OF SEA-WATER. Spence, R. (Univ. of Kent, Canterbury, Eng.). Talanta, 15: 1307-9(Nov. 1968).

A review of the literature on the uranium content of seawater is presented, with 17 references. (auth) (UK)

2432 STRONTIUM ISOTOPES IN OCEAN WATER AND MARINE SEDIMENTS. Murthy, V. Rama; Beiser, E. (Univ. of Minnesota, Minneapolis). Geochim. Cosmochim. Acta, 32: 1121-6(Oct. 1968).

The isotopic composition of Sr in the major oceans of the world is uniform at the present time; the average $^{87}Sr/^{86}Sr$ ratio is 0.7094 ± 0.0012 at the 95% confidence level. The clay fractions of the equatorial Atlantic deep sea sediments contain Sr of variable composition, not in isotopic equilibrium with ocean water. The Sr composition in the sediments is related to provenance and clay mineralogy. (auth) (UK)

2433 RADIOACTIVITY IN SURFACE AND COASTAL WATERS OF THE BRITISH ISLES, 1967. Mitchell, N. T. Technical Report FRL 2. Lowestoft, Eng., Fisheries Radiobiological Laboratory, 1968. 41p.

Studies are reported under the following main headings: Working methods; sites operated by the United Kingdom Atomic Energy Authority; nuclear power station sites of the Central Electricity Generating Board and the South of Scotland Electricity Board; Channel Islands. It was found that radiation exposure from low-level liquid waste disposal was within internationally acceptable limits at all sites, and at many sites no contribution to radiation exposure of the public could be detected. (UK)

2434 DISTRIBUTION OF ^{137}Cs AND ^{90}Sr IN THE ARABIAN SEA AND BAY OF BENGAL. Sreekumaran, C.; Gogate, S. S.; Doshi, G. R.; Sastry, V. N.; Viswanathan, R. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India), 37: 629-31 (Nov. 20, 1968).

Data are presented on the latitudinal distribution of ^{137}Cs and ^{90}Sr in the Arabian Sea and Bay of Bengal as measured in 1963 to 1963, and in the surface coastal waters off the west cost of India as measured in 1963 to 1964. The equipment and methods are described, and the results are tabulated. (L.C.L.)

Seismology

Refer also to abstract 2441.

2435 SOURCE PARAMETERS OF EARTHQUAKES, AND DISCRIMINATION BETWEEN EARTHQUAKES AND NUCLEAR EXPLOSIONS. Davies, John B.; Smith, Stewart W. (California Inst. of Tech., Pasadena). Bull. Seismol. Soc. Amer., 58: 1503-17(Oct. 1968).

A technique by which the source parameters of an earthquake can be obtained from the spectrum of compressional waves is described. The source parameters defined are fault length, fracture velocity, and fault plane attitude. Two large, deep earthquakes are examined using this technique. The source parameters determined compare favorably with those obtained previously using different techniques. A method is proposed for discrimination between underground explosions and earthquakes. The technique utilizes the ratio of the spectrums of the two classes of events where the path of propagation is common to both. On the basis of the analysis of the SHOAL event and a nearby shallow earthquake it appears that the duration as determined from the spectral ratio is almost 10 times smaller for an explosion than it is for a comparable earthquake. (auth)

2436 DOES EPICENTRE SOURCE BIAS EXIST? Douglas, A. (United Kingdom Atomic Energy Authority, Blacknest, Eng.); Lilwall, R. C. Nature (London), 220: 469-70(Nov. 2, 1968).

Reference is made to a nuclear explosion detonated underground in the Aleutian Islands on Oct. 29th, 1965 ("Longshot"). A study of the seismic waves generated indicated that the arrival times of P waves at stations on azimuths to the north of the Aleutian arc were earlier than predicted, whereas arrival times to the south were usually later than predicted. Epicentres computed by standard methods from arrival times were consistently about 25 km to the north of the true epicentre. This phenomenon is described as travel time bias, and was not recognized before the firing of "Longshot"; it was not apparent in other large explosions. This travel time bias has been interpreted as originating near the explosion source, and a possible near source structure has been proposed to account for it. It is suggested that there is no evidence of source bias and that the observations indicate plausible differences, between recording stations, in the underlying upper mantle structure. If this is true, then by applying time corrections for these differences in structure it should be possible to obtain a good estimate of the "Longshot" epicentre without invoking extreme upper mantle structure at the source. The studies of Herrin and Taggart (Bull. Seis. Soc. Amer., Vol. 58 (in press)) in this connection are discussed. Errors in epicentre location, with and without station corrections, are tabulated for a number of events (including "Longshot" and the Hawaiian earthquake of 28th June, 1962). Analysis assumed that the travel time curve was essentially correct. (UK)

2437 A NOTE ON INFRASONICS AT UKAEA BLACKNEST. Grover, F. H. Geophys. J. Roy. Astron. Soc., 16: 311-15 (Oct. 1968).

Microbarograph records of large explosions in the atmosphere have been published during the past decade, and it is thought that observations by arrays of microbarographs, followed by a compilation of results on a world-wide scale may yield useful information about the Earth's atmosphere. Apart from the value of the directional and velocity-finding properties of arrays, the gain in signal-to-noise ratios which they provide enables very small infrasonic signals to be used for this purpose. An array of microbarographs was established at Blacknest to provide an improved capability in recording and analysis of infrasonic waves of small amplitude. An adaptation of an array processing method developed originally for seismic signals is described and two examples of applying this method to small infrasonic signals are given. (auth)

2438 SEISMIC METHODS FOR MONITORING UNDERGROUND EXPLOSIONS. An Assessment of the Status and Outlook. Stockholm, International Institut for Peace and Conflict Research (SIPRI), 1968. 130p. $2.50; £1.0.0; Sw.Cr. 10:-. (NP-17675).

The work of a group of seismologists from ten countries who met in April and June of 1968 to examine the usefulness of networks for the detection and identification of underground explosions by seismological means only is reported. General seismological terms are defined and techniques described. Procedures used in the various countries for the detection and location of seismic events, both earthquakes and explosions, are described. The results of methods used for distinguishing earthquakes from explosions are presented. Several appendixes provide technical information on decoupling, amplitude and yield relationships, magnitude problems, etc. One appendix refers to the historical background and implementation of UN Partial Test Ban Treaty. It is concluded that it is now possible with existing seismological networks to distinguish explosions from earthquakes, and further, to identify the size of explosion down to 10 kt in granite. Further research is recommended in methods for improving identification, particularly for lower yield explosions. (L.C.L.)

2439 SOME PRESSURE OSCILLATIONS OBSERVED IN INDIA AND THEIR PROBABLE ASSOCIATION WITH THE CHINESE NUCLEAR TEST 1965. Vittal Sarma, V. Curr. Sci. (India), 37: 633-6(Nov. 20, 1968).

Barograph data measured at numerous places in India between May 13 to 20, 1965 are examined and related to the May 65 Chinese nuclear test explosion. The information strongly suggests that direct, as well as "round-the-world," pressure waves following the Chinese nuclear explosion were responsible for the impulses on the microbarographs over India. (L.C.L.)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 2184, 2437, 2464, 2474, and 2705.

2440 (LA–4014) ELIMINATION OF FLUTTER IN THE RADIO FLASH CODE. Richtmyer, R. D. (Los Alamos Scientific Lab., N. Mex.). Sept. 9, 1968. Contract W-7405-eng-36. 8p. Dep. CFSTI.

Efforts to eliminate computation oscillations from the radio flash code EMP developed for the CDC-6600 computer led to investigation of an alternative difference system that is more dissipative in character. Several modifications of the new difference system were considered and a normal-mode analysis was made for each, with the result that the modification described in this report appeared to be relatively free of flutter and more stable than the original difference scheme. The modification has not yet been tested in the environment of full calculation. (auth)

2441 (PNE–1113) CLOSE-IN GROUND MOTION AND EARTH STRESS. A WET MEDIUM: 140-TON ROW-CHARGE CRATERING EXPERIMENT IN VARYING TERRAIN. Project PRE-GONDOLA II. Joachim, Charles E. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Oct. 1968. 74p. Dep. CFSTI.

Stress, particle velocity, and acceleration data were obtained from a 140-ton nitromethane row-charge detonation in a saturated clay-shale. The charge row consisted of two 40- and three 20-ton spheres (first and fourth charges were 40 tons) extending S 11 W from the Pre-GONDOLA I Charlie crater on an 80-foot spacing (first charge 105 feet from crater center). The primary instrument line (stress and particle velocity gages) extended S 79 E from the center charge (G) with gage stations 100, 150, 200, 300, and 400 feet from G. Gage depths were 10 and 50 feet except the 400-foot station which was gaged at 50 feet only. Acceleration measurements were made on the slopes of the Pre-GONDOLA I Delta and Charlie craters and at the Control Point (CP). Peak stress measurements were higher than Pre-GONDOLA I data. As the charge-to-gage distance increased, the individual compressional waves from the various charges began to coalesce. The resulting stresses (coalesced wave) scale using combined charge weights and cube root scaling. Initial peak horizontal velocity compares well with Pre-GONDOLA I data. Similar to stress, velocities resulting from the coalesced shock front scale using cube root. A low-amplitude, long-duration acceleration was recorded at the Delta and Charlie craters. The fractured crater material filtered out the high-frequency, high-amplitude motions anticipated at the crater slope and lowered the average propagation velocities. CP accelerations compare well with predictions based on competent media. (auth)

2442 (PNE-G–22) FLOWMETER TESTS IN GB-2RS. Lombard, David B.; Korver, John (California Univ., Livermore. Lawrence Radiation Lab.). June 23, 1968. 15p. Dep. CFSTI.

An experiment was performed to measure the postshot gas flow in the Gasbuggy-2RS hole at depths between 3700 to 4500 ft. The equipment and procedures for drilling and casing the borehole, measuring the flow rates, and recording the data are described. Three flowmeters were used. One became inoperable due to jamming of the meter turbines by particulate matter in the gas stream. One meter was used at depths from 3700 to 4100 ft and the other at 4100 to 4500 ft. Both meters were unreliable when operated beyond their recommended maximum operating flow rate. From the flow measurements made it was concluded that 52.2% of the total gas flow entered GB-2RS between 3700 to 3912 ft, 17.7% between 3912 and 4060 ft, 14.2% between 4060 to 4102 ft, and at least 16.8% below 4325 ft. Specific recommendations are made for improving the flow metering system. (L.C.L.)

2443 RESULTS OF THE CABRIOLET EXCAVATION EXPERIMENT. Tewes, Howard A. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 536-7 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2444 PROJECT BUGGY: A NUCLEAR-ROW EXCAVATION EXPERIMENT. Toman, John (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 537-8 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2445 THE CORPS OF ENGINEERS NUCLEAR CONSTRUCTION RESEARCH PROGRAM. Day, Walter C. (Nuclear Cratering Group, Livermore, Calif.). Trans. Amer. Nucl. Soc., 11: 538 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2446 TEN YEARS OF CRATERING RESEARCH: A REVIEW. Vortman, Luke J. (Sandia Corp., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc., 11: 538-9 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2447 NUCLEAR EXCAVATION DESIGN OF A TRANSISTHMIAN SEA-LEVEL CANAL. Hughes, Bernard C. (Nuclear Cratering Group, Livermore, Calif.). Trans. Amer. Nucl. Soc., 11: 539 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2448 DEPENDENCE OF CAVITY SIZE ON THE YIELD STRENGTH OF THE GROUND AND MATERIAL DESCRIPTION OF THE CAVITY GAS. Allen, R. T. (Systems, Science and Software, La Jolla, Calif.); Duff, R. E.; Johnson, W. E. Trans. Amer. Nucl. Soc., 11: 540 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2449 EXPERIMENTS AND CALCULATIONS OF SPHERICAL STRESS WAVES IN EARTH MEDIA. Godfrey, Charles S. (Physics International, San Leandro, Calif.). Trans. Amer. Nucl. Soc., 11: 540-1 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2450 SOURCE OF AIR BLAST FROM AN UNDERGROUND EXPLOSION. Montan, Donald N. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 541-2 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2451 GASBUGGY STATUS REPORT. Randolph, Philip L. (El Paso Natural Gas Co., Tex.). Trans. Amer. Nucl. Soc., 11: 542 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2452 ELAT: DEAD SEA WATERWAY. Talley, Wilson K. (Univ. of California, Davis). Trans. Amer. Nucl. Soc., 11: 542-3 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2453 FEASIBILITY OF STORING NATURAL GAS IN UNDERGROUND CHAMBERS CONSTRUCTED WITH NUCLEAR EXPLOSIVES. Witherspoon, P. A.; De Pasquale, D. L. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc., 11: 543 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2454 DESIGN OF LARGE-DIAMETER CASING FOR EMPLACEMENT BORINGS WITH ADVANTAGE TAKEN OF PLACEMENT GROUTING. Cheney, James A.; Porter, Craig S. (Univ. of California, Davis). Trans. Amer. Nucl. Soc., 11: 543-4 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2455 NUCLEAR EXCAVATION: THEORY AND APPLICATIONS. Knox, Joseph B. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 536 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2456 ATMOSPHERIC NITROGEN FLUORESCENCE DETECTION APPARATUS. Westervelt, Donald R. (to United States Atomic Energy Commission). U. S. Patent 3,413,467. Nov. 26, 1968.

A fluorescence detection apparatus for the detection of nuclear explosions in space is described comprised of a wide angle optical system, a wavelength selector for selection of a strong nitrogen molecular emission, a photo cell for transforming said emission into an electrical signal and amplification of said signal. (AEC)

2457 POTENTIAL EFFECTS OF PROJECT CHARIOT ON LOCAL WATER SUPPLIES, NORTHWESTERN ALASKA. Piper, Arthur M. Geological Survey Professional Paper 539. Washington, D. C., Department of the Interior, 1966. 49p. GPO.

Project Chariot—once planned as a nuclear-excavation test in northwestern Alaska—presumably might introduce some radioactive nuclides into local water supplies. An order-of-magnitude appraisal of the expectable concentrations of such nuclides in streams and other water sources was developed. The appraisal is reported because it is unique in scope and because its results are applicable generally to preliminary evaluations of other proposals for nuclear excavation. Project Chariot would involve simultaneous detonation of one 200-kiloton and four 20-kiloton nuclear explosives, all emplaced below the land surface. Expectable vented radioactivity would be 1,500 megacuries due to mixed fission products, including 3,000 curies due to ^{90}Sr, 3,000 curies due to ^{137}Cs, and 100,000 curies due to ^{131}I. This radioactivity would be dispersed downwind as fallout; about 50 percent within a distance of 2 miles from ground zero, 75 percent within 10 miles, and 90 percent within 30 miles. The area receiving fallout (radioactivity more than 0.005 megacurie per square statute mile) would be some 1,500 square miles and would have a maximum downwind reach of about 125 miles. Subsequent redispersal of the fallout in and by water of the area is analyzed for four hypothetical cases, which together span the yearly range in hydrologic conditions. The four cases assume: (case I) detonation 30 days prior to breakup in the spring, ordinarily in April, fallout being on continuous snow cover; negligible redistribution of fallout by the wind; snowmelt runoff of 1 inch over the area, within 30 days following breakup; snowmelt detained in microponds (minute pools), 0.3 inch over the area; (case II) detonation at the close of melt-water runoff, ordinarily in early June; within the 30 days following detonation, a precipitation total of 0.5 inch but not more than 0.1 inch in any one storm; runoff averaging 0.03 inch but none generated by rain during the 30-day period; (case III) detonation in early August, following 2 months of minimum precipitation and an accumulated soil-water deficiency of 1 inch; within the 30 days following detonation, rainfall of 2.5 inches generating runoff of 0.7 inch; (case IV) detonation in late September, 10 days prior to to freezeup, fallout being on saturated tundra; in the 10-day interim, no precipitation and 0.1 inch of runoff. Among the four hypothetical cases, the radioactivity interjected in streams owing to dissolved nuclides would be by far the least in case III, as detonation in early August would be followed by heavy rains. For the more distant parts of the fallout area this activity would be less than the lifelong drinking-water standard. Activity in the streams due to suspended fallout particles would be nearly zero in case II, as detonation ordinarily in early June would be followed by light rainfall and minimum runoff. Total stream burden would be greatest in case III, which encompasses an interval of high momentary streamflow but moderate average flow. Activity that does not reach the streams soon after detonation would of course remain in the area—adsorbed on land-surface materials, infiltrated to soil water or ground water, or dispersed over the land surface as insoluble particulate matter. In the aggregate, this remaining activity would include the greater part of that vented. Insoluble particles on the land surface would probably move to the streams over a period of years, ordinarily in concentrations progressively less with each passing year. For most of the area, the management problems should vanish within a few years. (auth)

Facilities and Equipment

Refer also to abstracts 2442, 2533, 2540, 3401, 3416, 3419, 3420, 3425, 3428, 3429, 3431, 3486, 3627, and 3873.

2458 (BAW-1280-55) SODIUM TO STEAM HEAT EXCHANGER ELEMENTS AND RESEARCH. Interim Report. Preliminary Steam Generator Concept Selection Study. (Babcock and Wilcox Co., Barberton, Ohio. Power Generation Div.). Aug. 5, 1968. Contract AT(11-1)-1280. 94p. Dep. CFSTI.

In order to select the most optimum steam generator design for the Liquid Metal Fast Breeder Reactor Program, ninety-six possible designs were considered. From these, five alternates and a reference design were selected for further study. The selected designs were: No. 1 Modular, Forced recirculation, Drainable, Vertical Straight Tube Unit; No. 2 Modular, Once-through, Drainable, Vertical and Horizontal Straight Tube Units; No. 3 Modular, Once-through, Drainable, Horizontal, U-Tube Unit; No. 4 Large, Once-through, Drainable, Vertical, Return Bend Unit; No. 5 Large, Once-through, Drainable, Vertical, Helical Coil Unit; and No. 6 (Reference Design)—Large, Once-through, Undrainable, Vertical, Helical Coil Unit. The program plan for the preliminary analysis of the selected designs has been made and included in the report. The result of this analysis will be the selection of the most optimum sodium heated steam generator design. (auth)

2459 (GAMD-8012) TESTING OF PROTOTYPE ELECTRICAL PENETRATION CONNECTORS FOR PRESTRESSED CONCRETE REACTOR VESSEL. Bennett, B. G. (Gulf General Atomic, Inc., San Diego, Calif.). July 1, 1968. Contract AT(04-3)-633. 39p. Dep. CFSTI.

A test program was performed to evaluate prototype electrical connectors to be used for penetrating prestressed concrete reactor vessels (PCRV) with electrical conductors. Connectors from seven manufacturers were tested for helium leak rate under fixed and cycling pressure and temperature conditions, for electrical insulation integrity, and for hydraulic pressure failure. The test equipment and procedures are described. One prototype connector was found to be superior to the others and met all the design requirements. (L.C.L.)

2460 (KFK-735) HIGH EFFICIENCY HYDRAULICALLY DAMPED SPRING ASSEMBLY AS BRAKING AND CUSHIONING ELEMENT FOR NUCLEAR REACTOR CONTROL RODS. Muehlhaeuser, O. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Feb. 1968. 87p. (In German). (EUR-3720). Dep.

In the core of a reactor damped spring assemblies are necessary in two places: in the disconnect rod for the deceleration of the rods in the scram fall and underneath the fuel bundle for the cushioning of the bundle. Such a damping of cushioning appears appropriate by a damped elasticity. This type of cushioning element consists of a spring coupled with a damper. In liquid cooled or moderated reactors it is advantageous to introduce a hydraulic damper which uses the coolant and moderator as a medium. In the steam-cooled reactors this liquid is water, which has a relatively low viscosity, especially when used at high temperature. A spring form with damping was developed and tested in a Plexiglas model that is completely different from conventional construction. The spring consists of a single saddle-shaped arched disc similar to a cup spring, which was connected to a package and introduced into a vessel. The damping occurs through the pressure of the liquid between the individual spring discs and the vessel wall. The spring characteristics were theoretically determined and confirmed by measurements on a Plexiglas model. (tr-auth)

2461 (N-68-27049) LARGE CONTAINMENT CAPSULE FOR NUCLEAR REACTOR IRRADIATION OF EXPLOSIVE MATERIALS. Avrami, Louis; Dalrymple, Everett; Schwartz, Frank (Picatinny Arsenal, Dover, N. J.). Apr. 1968. 103p. (NASA-CR-95102; PA-TR-3673; AD-668674). CFSTI.

The design and development of a large explosive containment capsule for the irradiation of up to 80 grams of explosive materials is described. The capsule will fully protect its surroundings, e.g., the core of a nuclear reactor, if its explosive content detonates. The minimum safety factor of two was used. The capsule contains provisions for the containment of gases produced by detonation or burning of the explosive material and the minimizing of any shock wave propagated outside the capsule. Also, provisions are made to monitor pressure or gas evolution and the temperature of the test material during irradiation. Dynamic pressure pulse and stress-strain measurement tests were conducted and are described. Analytical calculations were made for comparison with experimental data, first to determine the validity of the calculations and then to obtain information on configurations not actually tested. (STAR)

2462 (NYO-3839-3) EXPERIMENTAL STUDY OF AN EXTERNALLY-PRESSURIZED, STEAM LUBRICATED, SINGLE-RESTRICTOR, CIRCULAR THRUST BEARING. Topical Report No. 3. Orcutt, F. K.; Malanoski, S. B. (Mechanical Technology Inc., Latham, N. Y.). Aug. 1968. Contract AT(30-1)-3839. 79p. (MTI-68-TR-35). Dep. CFSTI.

Results of an experimental study to develop a practical steam-lubricated thrust bearing are reported. Instruments used to measure experimental variables are described, theories for externally pressurized bearings are developed, rotor surface temperature and film pressure measurements are tabulated, and the effect of steam hammer instability is discussed. (P.G.C.)

2463 (NYO-3839-4) DESIGN OF AN EXPERIMENTAL STEAM-LUBRICATED ROTOR-BEARING SYSTEM. Orcutt, F. K.; Malanoski, S. B.; Streifert, K. L. (Mechanical Technology Inc., Latham, N. Y.). Sept. 1968. Contract AT(30-1)-3839. 65p. (MTI-68-TR-43). Dep. CFSTI.

The design, construction, and experimental operation of a multi-bearing rotor system wherein the rotor is supported entirely by steam-lubricated bearings is described. The system consists of the rotor with two externally-pressurized steam-lubricated journal bearings and one thrust bearing which is also steam-lubricated and externally-pressurized to support and position the rotor. Systems are described to generate, control and process the steam

lubricant; drive and rotate the shaft at speeds from several hundred to 7500 rpm; apply steady state radial and dynamic loads to the rotor; control heat loss from the rotor and bearing housing; and an instrumentation system to permit control of the operating and environmental variables and to measure performance of the bearing rotor system. Design parameters for the experimental journal and thrust bearings are given. (F.S.)

2464 (UCRL-71024(Rev.1)) DESIGN PRACTICES FOR EMP PROTECTION OF MILITARY SYSTEMS. Wouters, L. F. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 10, 1968. 45p. (CONF-680450-1). Dep. CFSTI.

From Technical Cooperation Program Panel N-4 Meeting, London, England.

A form of engineering analysis is discussed for practical electromagnetic protection of hardware in nuclear testing where the following conditions may exist: EM fields as high as 10^5 V/m and 100 G; rise times of 10^{-8} sec; frequency components up to 100 MHz; very low sensitivity components around 10 kHz; and electrical noise effects. System aspects, circuit layout, shielding, grounding, cabling, protective devices and techniques, and component susceptibility are considered. Engineering practice rules are given in an appendix for leakage, apertures, and penetrations in the design of the system; circuit layout; shielding; cabling; grounding; and protective devices and methods. (F.S.)

2465 (Y-1611) ULTRA PRECISION MACHINE TOOL ELEMENTS AND MACHINING PROCESSES. Lewis, T. G. (Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Engineering Dept.). Oct. 17, 1968. Contract W-7405-eng-26; Subcontract 51Y32100-C. 190p. Dep. CFSTI.

For Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

Engineering principles, as they apply to ultraprecise machining processes, were investigated as a part of a continuing program in the study of machine tools. In this machining process, maximum deviation from an idealized shape and size was not to exceed a few microinches. Phases of the study reported include development of an experimental research machine that would be limited to turning solid hemispheres, but would deviate no more than 25 microinches from a four-inch diameter at any point on the hemisphere, and studies on the effects of material hardness and associated parameters on the machine tool elements and processes. Multistage operations are applied to machining a sphere with a deviation not to exceed five microinches, and a new and more versatile experimental machine that would be able to fabricate more delicate and complex test pieces is investigated. A new experimental machine tool called the hemishell turning machine which represents the epitome in ultraprecision machining technology was developed. (auth)

2466 (Y-1630) CORNERING PROBLEM IN ADAPTIVELY CONTROLLED METAL CUTTING. Kahl, K. G. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Oct. 28, 1968. Contract W-7405-eng-26. 121p. Dep. CFSTI.

A survey of adaptive control for metal cutting is presented, and a parameter adjustment model using fixed-increment sequential parameter adjustments and switching boundaries is developed. The adjustment model, used in conjunction with an adaptive control system, is used to solve a cornering problem encountered in numerically controlled metal cutting. A computer program is used to statically test the adjustment model in a variety of simulated conditions. (auth)

2467 EXPOSING ARTICLES TO A SOURCE OF IONIZING RAYS. (to Saint-Gobain Techniques Nouvelles). British Patent 1,133,449. Nov. 13, 1968. Priority date Dec. 2, 1964, France.

Equipment is described for irradiating substances with a uniform radiation dose in a short time. The apparatus is light in weight in relation to the intensity of radiation and suitable for mounting in a truck. The substance to be irradiated is exposed to a 2 element flat source mounted in a shielded chamber enclosed on three sides with walls consisting of lead encased in metal, the fourth open side has an entrance-exit lock formed by jaws formed by the chamber walls partially enclosing a drum. The drum is used in moving containers holding the substances to be irradiated in and out of the chamber. In the chamber the containers are moved in a pattern around the source. (F.S.)

2468 AN ARRANGEMENT FOR CONNECTING DUCTS. Mejan, Maurice (to Commissariat a l'Energie Atomique). British Patent 1,131,565. Oct. 23, 1968. Priority date Sept. 21, 1965, France.

An arrangement for remotely connecting and disconnecting two flanged ducts is described. The flanges have parallel facing surfaces and rear surfaces which are inclined with respect to the facing surfaces. Two coupling members with surfaces consisting of balls or rollers contact the rear surfaces of the flanges. An articulated arm is used in remotely controlling the coupling member. (F.S.)

2469 DOUBLE WALL HEAT EXCHANGER (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1784).

1 drawing.

A double-walled heat exchanger, to remove the heat of compression from a high-speed compressor used in the Fluidized Bed Volatility Process, is described. An annular space containing short, high efficiency fins or ribs integrally connected to two tubes acts as a buffer zone between potentially hazardous fluids and prevents intermixing. Copper is used as the material of construction for the integrally finned tube and Monel is used for the jacket of the heat exchanger. (For details see TID-4100 Suppl. 48) (F.S.)

2470 VELOCITY READOUT (Engineering Materials). (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). (CAPE-1780).

3 drawings.

A noncontact optical-electronic velocity measurement system designed for use with a pendulum-type impact tester is described. Velocity is measured with an optical-electronic-generated, time-interval measurement from a distance template. The time required for the pendulum to traverse two known distances one before and one after impact is measured. The distances are established by two sets of reflecting marks on a template mounted on the pendulum hammer. A photosensor and light source combination detect the passing marks and the time is measured by a counter timer combination providing for calculation of input energy and energy remaining after impact. An accuracy of ±0.05 ff lb has been observed. (For details see TID-4100 Suppl. 48) (F.S.)

2471 ION EXCHANGE TRAPS CHROMATES FOR REUSE. Richardson, E. W.; Stobbe, E. D.; Bernstein, S. (Union Carbide Corp., Paducah, Ky.). Environ. Sci. Technol., 2: 1006-16 (Nov. 1968).

Chromate ion is a chemical used to inhibit corrosion in recirculating cooling water. Since the chromate ion is a pollutant, it should not be discharged into receiving waters. A study was made to recover and reuse chromates in a pilot plant project covering extent of chromate pollution abatement, feasibility of chromate recovery and reuse, useful resin life, raw material and manpower requirements, and scale-up criteria. The exchange columns, testing, and results are described. Results show that an ion exchange system could be used to recover the chromates discharges from a RCW system and help maintain the concentration at an acceptable level for discharge into surface streams. (J.C.W.)

2472 APPARATUS FOR THE SEPARATION OF RADIOELEMENTS. Eudes, Marcel; De Vernejoul, Pierre (to Societe Saint-Gobain Techniques Nouvelles). British Patent 1,132,873. Nov. 6, 1968. Priority date Feb. 10, 1965, France.

The design of a device for utilizing daughter products from long-lived radioelements for medical and other applications is given. The apparatus consists of hypodermic needle devices with proper shielding, sterilizing filters, and pumps for proper uses. The operation is described. Barium-137, gallium-68, iodine-132, lanthanum-140, and yttrium-90 are of practical applications. (J.C.W.)

2473 IMPROVEMENTS IN OR RELATING TO MACHINE TOOLS. Smith, Leonard Henry; Taylor, Samuel (to United Kingdom Atomic Energy Authority). British Patent 1,132,011. Oct. 30, 1968. Filed Mar. 4, 1965.

A method of repetitiously welding abutting faces of metal strips using a drilling machine is described. The spindle of a drilling machine is removed and replaced with an electrode head which is used for the welding operation. This method is adaptable for welding the grids of nuclear fuel rods or other rod-like articles with a high degree of accuracy. (F.S.)

2474 PEAK-STRESS GAUGE FOR DETERMINING THE YIELD OF UNDERGROUND NUCLEAR DETONATIONS. Larson, D. B.; Sisemore, C. J. (Univ. of California, Livermore). J. Appl. Phys., 39: 5609-12(Nov. 1968).

A spherically shaped, stress-sensitive plastic gage designed by Power and Lombard in 1966 is described in terms of a phenomenological model. The predictions presented are based upon a semi-empirical description given by Allison and Hauver in their work on uniaxially loaded flat Plexiglas disks. The model description is shown to be consistent with both the data of Power and Lombard and data reported in this paper. The anomalous gage behavior reported by Power and Lombard is attributed to effects of the external circuit. This observation has led to a new circuit design

which allows a sensitive measure of stress from 50 to 230 kbar. These results suggest that this gage would be useful for obtaining hydrodynamic energy yield when used in conjunction with computer-code calculations of shock-wave effects associated with underground nuclear detonations. (auth)

2475 BACHELOR DEGREE TECHNICIANS. WHAT POTENTIAL EMPLOYERS THINK. Waite, David A.; Eger, Kenneth J. (Oklahoma State Univ., Stillwater). Trans. Amer. Nucl. Soc., 11: 437-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2476 GRADUATE-LEVEL COURSES ON STRUCTURAL ENGINEERING FOR NUCLEAR FACILITIES. Jaeger, Thomas A. (Technical Univ., Berlin). Trans. Amer. Nucl. Soc., 11: 435 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2477 INFLUENCE OF RESIDUAL STRESS ON YIELD AND ELASTIC BUCKLING OF TUBES UNDER EXTERNAL LATERAL PRESSURE. Haskell, Donald F. (Hittman Associates, Inc., Columbia, Md.). Trans. Amer. Nucl. Soc., 11: 641-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2478 UNDERWATER REMOTE HANDLING SYSTEMS. Hunley, William H.; Jones, Robert A. (Naval Ship Engineering Center, Washinton, D. C.). Trans. Amer. Nucl. Soc., 11: 617(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2479 APPLICATION OF REMOTE MANIPULATORS IN SPACE. Blackmer, R. H. (General Electric Co., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 11: 617-18(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2480 TRANSIENT THERMAL STRESSES PRODUCED IN ELASTIC CYLINDERS, SPHERES, AND FLAT PLATES. Buttemer, David R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 640-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2481 FLUIDICS. Delarue, C. Energ. Nucl. (Paris), 10: 308-18(Sept. 1968). (In French).

A brief review is made of the historical reasons which led to the existence of the original science of fluidics, and the principles used in this new technique for hydraulic and pneumatic monitoring without moving parts are explained. The main fields of application already explored are defined, and applications to various types of measuring, speed governing, and handling are described. Explanations are given as to why fluidics are particularly suitable for detecting, monitoring, and automating in rigorous environments and, therefore, for atomic energy. (auth)

2482 MECHANISM OF CONDUCTION IN LIQUID DIELECTRICS IRRADIATED WITH ALPHA AND BETA PARTICLES. Chybicki, M. (Danzig Technical Univ.). Acta Phys. Pol., 34: 445-55(1968).

Experimental results previously obtained were used as the basis for checking the correctness of the columnar theory of ionization and conductivity devised by Jaffe. A large discrepancy between the results of experiments and those calculated from Jaffe's theory was found. At the same time a new model of charge collection in an electric field is proposed. Its conception is based on estimating the number of δ electrons whose range in the liquid is large enough that the parent ion—δ electron interaction is smaller than the forces acting from the side of the external field. With the assumption that only such δ electrons take part in the measured current, the theory has been compared with experiment and satisfactory agreement has been received. (auth)

2483 ELAN II B. PILOT PLANT FOR THE MANUFACTURE OF CESIUM SOURCES. Courouble, J. M.; Rozand, L. (CEA, Paris). Energ. Nucl. (Paris), 10: 297-302(Sept. 1968). (In French).

Research on the extraction of cesium from uranium fission product solutions, has led to the development of a mineral ion exchanger. The process operates under the name of Elan Project. The need to modify the chemical nature of the initial solution is avoided, and the charged ion exchanger contained in a lead flask, can be used to transport the cesium from a fuel processing site to a recuperation and source manufacturing plant. After perfecting the process on a pilot scale the C.E.A. has undertaken the construction of two plants: Elan II-A at Marcoule, where cesium is fixed on the ion exchanger; and Elan II-B at La Hague, in charge of elution, treatment of the eluate and manufacture of sources in the form of chloride or insoluble silico-aluminate. The Elan II-B plant (floor area 48 × 28 m, total volume 16,700 m^3) including a set of blind chemistry cells and a series of cells equipped with telemanipulators for the manufacture of sources is described. The work began in May 1967 and inactive tests are due to start late in 1968. (auth)

2484 GAMMA IRRADIATION FACILITIES. Com. Naz. Energ. Nucl., Notiz., 14: No. 10, 88-100(Oct.f 1968). (In Italian).

A review of certain types of gamma irradiation facilities and their possible applications. (auth)

2485 FLUOROCARBON-LINED GLOVEBOX. Delnay, Robert L.; Grill, L. F.; Holst, J. L. (to United States Atomic Energy Commission). U. S. Patent 3,410,619. Nov. 12, 1968.

A glovebox lined with a fluorocarbon layer and having additional flourocarbon material overlapping various portions and surfaces is described. (AEC)

2486 IMPROVEMENTS IN/OR RELATING TO SYSTEMS FOR INTRODUCING OR REMOVING OBJECTS SUCH AS LIGHTING LAMPS INTENDED FOR RADIO-ACTIVE ENCLOSURES. (to Commissariat a l'Energie Atomique). British Patent 1,132,404. Oct. 30, 1968. Priority date Aug. 4, 1966, France.

A system for introducing and removing objects, such as electric light bulbs from a shielded enclosure or hot cell in which radioactivity is present while maintaining biological protection, is described. The system consists of an outlet for removing or introducing an object and a method of pivoting and orienting the object to or from the outlet. (F.S.)

2487 DEVELOPMENT OF NEW PROPULSION DEVICES IN THE U. S. POINTS THE WAY TO AEROSPACE PROGRESS. I. Fiorio, Franco. Riv. Aeronaut., 44: 1091-1112(June 1968). (In Italian).

A brief review is presented of advances and development prospects in the U.S. with respect to air-ingestion jet propulsion devices, solid-rocket propulsion devices, liquid-rocket propulsion devices, and advanced (nuclear, electric, etc.) propulsion devices. Advances made in the field of propellants and binders and the use of high-energy combustion additives are mentioned, together with progress achieved in the design of small sublimation rockets which are capable of achieving infinitesimal impulses in the control of spacecraft, and in the field of hybrid engines using a combination of solid and liquid propellants to achieve high performances for specialized uses. (IAA)

2488 A STRIKER OPERATING, TEMPERATURE-MEASURING AND AGITATING SYSTEM FOR A CONTROLLED-ATMOSPHERE INDUCTION FURNACE. Mercier, Claude (to Commissariat a l'Energie Atomique). British Patent 1,132,286. Oct. 30, 1968. Priority date Sept. 7, 1965, France.

A striker operating system used in fracturing the graphite sealing plate of a crucible in a controlled-atmosphere induction furnace is described. The plate is fractured to allow pouring of molten Pu metal from the crucible. The system consists of a vertical tube above the furnace, hermetically sealed between the furnace and the tube, a bellows extendible by a pneumatic ram, and a hollow striker which is driven by a motor through a toothed rack, and a stopper for the striker. The striker has a temperature measuring method. (F.S.)

2489 APPARATUS INCLUDING SAFETY VALVE. George, Brian Victor (to English Electric Co., Ltd.). British Patent 1,132,355. Oct. 30, 1968. Filed May 14, 1965.

An apparatus for producing a vapor under pressure by heating a fluid in a heat exchanger is described. The apparatus is suitable for use as a vapor generator in a reactor. A safety valve responsive to the difference in pressure between the vapor and the fluid releases the vapor. (F.S.)

2490 IMPROVEMENTS IN AND RELATING TO FLAW DETECTORS. Baran, Miroslav (to Statni Vyzkumny Ustav Materialu). British Patent 1,131,296. Oct. 23, 1968. Priority date May 27, 1966, Czechoslovakia.

A carriage used to introduce a radioactive source into a pipeline during radiographic inspection for detecting welding flaws is described. The carriage consists of driving wheels, a steering wheel, a frame, means for sensing rotational movement of the carriage, and a radioactive source. (F.S.)

2491 HIGH POWER X-RAY FACILITIES AND THEIR USE FOR THE RADIATION PASTEURIZATION OF FRESH FISH. Hofmann, E.-F.; Offermann, B.; Stolle, H. (AEG-Telefunken, Hamburg). Kerntechnik, 10: 547-54(Oct. 1968). (In German and English).

The shelf life of ice-cooled fish, such as cod and haddock can

be increased by 10 to 15 days by irradiating it on board ship, immediately after the catch, with a 100 krad dose of x or gamma radiation. Before this process is legally permitted in the German Federal Republic, it is necessary to carry out some investigations under practical conditions. Particularly suitable for shipboard research are x-ray irradiation facilities with flow-through anode tubes. X-ray irradiation facilities with tandem x-ray tubes are suitable for service both on land and at sea. Compared to isotope facilities, x-ray facilities have about the same depth of penetration and are more economical; they weigh less and are easier to install. X-ray facilities can be switched off, therefore, in case of damage they present no danger for the ship or the crew. (auth)

2492 ECM–ELECTROCHEMICAL MACHINING. Amer. Mach./Metalwork. Mfg., 111: 149-69(Oct. 23, 1967).

The electrochemical machining (EMC) process is explained in detail and its advantages enumerated. The equipment and method are described and illustrated. Tables are presented on the operating parameters, the choice of electrolytes to use for various metals and alloys, metal removal rates, and feed rates for five selected shapes. EMC is advantageous for planning, shaping an OD, contouring and trepanning, blanking of shallow shapes, cavity cutting, hole sinking, turning and cutoff. EMC is economical, quick, simple, has a long tool life, and leaves a fine finish with no metallurgical damage. EMC has been used extensively for machining gas-turbine aircraft engine parts. Further applications in other industries are predicted. (L.C.L.)

2493 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF MOULDED BODIES. Houdaille, Michel (to United Kingdom Atomic Energy Authority). British Patent 1,134,746. Nov. 27, 1968. Filed Dec. 14, 1964.

A molding apparatus is described for fabrication of nuclear fuels consisting of fissile oxides, carbides or nitrides with another zone of material around the fuel material. The apparatus has an outer mold wall and an inner mandrel defining an annular mold cavity. The contents of the outer cavity is compressed by opposed tubular plungers. The mandrel has a portion of reduced dimension which forms an inner wall of an inner annular mold whose outer wall is formed by the bore of the tubular plunger. The mandrel is displaceable relative to one of the plungers which brings the cavities into juxtaposition to unite the contents of the two cavities into a composite body. (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 2458, 2469, 2489, 3151, 4201, 4204, 4217, 4309, and 4455.

2494 (AEEW-R-448) SLIP: A DYNAMICS PROGRAMME FOR THE THERMAL–HYDRAULIC BEHAVIOUR OF BOILING LOOPS. Moxon, D. (Atomic Energy Establishment, Winfrith (England)). Aug. 1968. 50p. Dep. CFSTI. UK 7s. 0d.

SLIP is a dynamics programme (in FORTRAN) for solving the thermal-hydraulic equations describing an electrically heated rig. The heater may be a single tube cooled from within and insulated from the atmosphere externally, or it may be a bundle of heater rods each cooled on the outer surface. The axial power distribution is arbitrary. The hydraulic circuit consists of the heated section, a number of risers in series, a single-phase downcomer containing a pump and a single-phase bypass across the test-section and risers. There is no explicit representation of a steam drum. The system may be disturbed by imposing variations on power, inlet sub-cooling, inlet velocity or pump pressure head. Output includes axial distributions of heat flux, void fraction, coolant density, dryout margin, as well as loop pressure losses. An optional extra is a Fourier analysis of certain items of output enabling a calculated cyclic response to be represented in terms of the various harmonics. (auth)

2495 (ANL-7452) TRANSIENT FREE-CONVECTION HEAT TRANSFER IN LIQUID METALS IN VERTICAL RECTANGULAR CHANNELS. Heinisch, Roger P. (Argonne National Lab., Ill.). May 1968. Contract W-31-109-eng-38. 109p. Dep. CFSTI.

An analytical and experimental investigation of transient free convection in a narrow, vertical, parallel-plane channel following a step change in uniform wall heat flux is presented. In the analysis, the time-dependent boundary-layer equations are formulated for two-dimensional flow and heat transfer with no internal heat generation and constant physical properties, except in the body-force term. These equations are solved by a technique generally referred to as the method of integral relations. The analysis is checked by using the method of lines to ascertain the validity of the results. The results obtained by the two methods are generally in good agreement. Solutions are obtained for various Prandtl numbers. Two boundary conditions are considered in the analysis: constant wall temperature and constant wall heat flux. The construction of an experimental apparatus and instrumentation for various test sections is described. Three test sections were used to form a heated rectangular channel $6 \times 1 \times 10$ in. Test Section I consisted of both 6×10-in. faces heated by a uniform heat flux with mercury as the fluid; Test Section II, the same boundary conditions as Test Section I, with lead as a heat-transfer medium to thermally model the mercury; and Test Section III, one 6×10-in. surface heated by a uniform heat flux, with the second surface maintained at constant ambient temperature using mercury as the fluid. The experiments were performed with mercury since its small Prandtl number is typical of other liquid metals presently under consideration for use as fast-reactor coolants. Transient and steady-state heat-transfer results are reported. Initially the fluid was stagnant and at a uniform temperature. The transient was initiated by using radiant heating to suddenly increase the wall heat flux from zero to some constant preselected value. Temperature-time histories of the wall and fluid were recorded during the transient and steady-state periods at several locations on the wall and in the flow field. Developing local and average Nusselt numbers were determined for various operating conditions. The theoretical and experimental steady-state limiting cases were in good agreement. The results show that when the wall heat flux is sufficiently large on both faces, the mechanism for energy transport in the fluid is predominantly by conduction. For lower values of imposed wall heat flux or when one wall is maintained at a constant temperature, the steady-state condition was reached with convection as the predominant mechanism of heat transfer. Turbulence levels inferred from temperature-time traces in the fluid indicated that the fluid experienced a greater degree of local turbulence for Test Section III than for Test Section I. Approximate values of Rayleigh number are obtained for the transition for laminar to turbulent flow. Measurements in the inlet section indicate that axial conduction is quite small for all test sections used. Dimensionless temperature profiles are obtained for various axial locations in the duct for all test sections used. (auth)

2496 (EUR-4040) THE INFLUENCE OF ARTIFICIAL ROUGHNESS ON THE INCREASE IN THE CRITICAL HEAT FLUX OF WATER IN RING GAPS UNDER FORCED CONVECTION. PART I. UNDERCOOLED STATE AT MEASURING SECTION OUTLET. Burck, E.; Hufschmidt, W.; de Clercq, E. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr. 29, 1968. 82p. (In German). Dep.

The critical heat flux density (burnout) of subcooled water in an annular test section with inner heated smooth and rough tubes under forced convection conditions has been measured. The inner tube has been provided with artificial roughnesses of different forms (sandroughness, knurls, threads) and different heights (2.6 μ to 0.3 mm). It was found that in the tested range of parameters: outlet pressure, Po = 11 to 31 [bar]; mass flow-density, qm = 250 to 3500 [kg/m^{2}s]; and outlet subcooling, $T_s - T_o$ = 0 to 150 [°C], only with the highest roughness (>0.3 mm) could the critical heat flux densities be sensitively increased compared with the smooth surface. This increase of critical heat flux density, however, is relatively small compared with the increase of normal convective heat transfer coefficients without surface boiling on identically roughened surfaces. The measurement of pressure variations in the test section without and with heat supply up to the critical heat flux density is discussed. (auth)1)

2497 (NP-17658) FILM BOILING OF THE INSIDE OF VERTICAL TUBES WITH UPWARD FLOW OF THE FLUID AT LOW QUALITIES. Report No. 9079-26. Dougall, Richard S.; Rohsenow, Warren M. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). Sept. 1963. Contract NSF-G-21455. 107p. Dep. CFSTI.

Flow regimes, local heat transfer coefficients, and temperature distributions along the wall were studied for film boiling inside a vertical tube with upward flow of a saturated liquid. The area of interest was limited to cases of constant heat flux from the tube wall, small inlet liquid velocities, and film boiling which completely covers the entire heated portion of the tube. The last restriction means that there is no large region of nucleate boiling prior to the film boiling section. A visual test section made of electrically conducting glass tubing was used for flow visualization studies at low qualities. Visual observations with this test section have indicated that the flow regime is annular with liquid in the center and vapor along the walls of the tube. Based on interpretations of temperature distribution data, it was concluded that the annular flow regime changes at higher qualities to one of dispersed flow—where the liquid is dispersed in the form of drops through a predominately vapor flow. Two different diameter test sections made of stainless steel and heated electrically were used to obtain experimental data of temperature distributions along the tube wall

and local Nusselt numbers for different heat fluxes and flow rates. The fluid used in all the experimental tests was Freon 113. A theoretical derivation based on an annular flow model with turbulent flow in the vapor film has given good agreement with the experimental data at low qualities. A dispersed flow theory using a modified form of the Dittus and Boelter–McAdams equation seems to be an asymptote which the experimental data approach with increasing qualities. (auth)

2498 (NYO-3304-13) INVESTIGATION OF BOILING FLOW REGIMES AND CRITICAL HEAT FLUX. Final Summary Report. Report No. 797. Bergles, A. E.; Roos, J. P.; Bourne, J. G. (Dynatech Corp., Cambridge, Mass.). July 1968. Contract AT(30-1)-3304. 174p. Dep. CFSTI.

An investigation of boiling flow regimes and critical heat flux was conducted. The experimental facility consisted of a water loop and a recirculating steam loop supplying electrically heated test sections. The steam loop was found to be a practical and economical method of increasing the capacity of the facility. Film thickness and critical heat flux measurements established that the data obtained with two-phase inlet conditions were comparable to those obtained with single-phase inlet conditions, provided that the annular mixer was properly adjusted and the test section was sufficiently long. The instrumentation developed for study of the flow structure included a traversing electrical probe, for determination of the general flow regime and measurement of the thickness of the annular liquid film, and a traversing isokinetic sampling probe, for examination of core entrainment in annular flow. Detailed flow regime information was obtained for boiling water flowing vertically upward in circular tubes of 0.4 and 0.8 in. diameter with lengths varying from 2 to 8 feet. Inlet conditions were subcooled, pressures were 500 to 1000 psia, and mass velocities ranged from 0.2×10^6 to 4.0×10^6 lbm/hr-ft^2. The following flow regime boundaries were identified: bubble, slug, froth, and spray annular. The flow regime boundaries were found to be significantly altered by changes in pressure, tube length, tube diameter, and inlet temperature. For the conditions tested, the CHF locus does not exhibit any unusual behavior when the various flow regime boundaries (bubble, froth, and spray annular) are crossed. Measurements of film thickness were made for a wide range of conditions in the annular flow regime. At lower quality the adiabatic film thickness is considerably above that predicted by semi-empirical models, due to entrained vapor. With the exception of very high mass velocities, the film thickness proceeds smoothly to zero as the CHF condition is approached. In view of the direct relation of film thickness to the CHF condition, the electrical probe can be utilized as a burnout protection device. Under certain conditions, oscillating behavior was noted within the heated test section. The oscillations were considered to be acoustical in character, and a model was formulated which yields a reasonable prediction of the threshold and frequency of oscillation. The electrical probe was further demonstrated to be a valuable diagnostic tool for investigating the flow structure in a rod bundle. Detailed flow regime and film thickness measurements were made in several subchannels of a four-rod bundle. (auth)

2499 (WANL-TME-1136) VIBRATIONAL STABILITY OF A ROD IN TUBE WITH LAMINAR FLOW. Persin, W. J.; Warner, Paul C. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). [nd]. 27p. Dep. CFSTI.

The dynamic stability of a rigid, circular rod flexibly located in the center of a rigid circular tube was investigated for fluid flow between the rod and tube. The fluid flow is assumed to be compressible, laminar and isothermal, and end effects are neglected. Stability limits are determined in terms of flow and geometric variables, and are presented in chart form. The special case where the rod is uniform and of length equal to the flow path is presented in detail. (auth)

2500 FLOW INSTABILITY THRESHOLDS IN PARALLEL HEATED CHANNELS. Masini, G.; Possa, G.; Tacconi, F. A. (Laboratori CISE, Milan). Energ. Nucl. (Milan), 15: 773-82 (Dec. 1968).

An experimental program was conducted on parallel channel flow instability. A circuit made up of two identical heated channels hydraulically connected in parallel was used to determine the flow instability thresholds. More than 200 flow instability threshold conditions were determined and tabulated. It was concluded that the mechanism of flow instability is of a dynamic nature; that the power to the heated elements which causes the inception of flow oscillations increases with flow rate, pressure, and hydraulic resistance in the liquid region, and decreases with increasing hydraulic resistance in the two-phase flow region; and that the period of the flow oscillations, in most cases, is clearly proportional to the volumetric transit time in the heated elements. (L.C.L.)

2501 DISCONTINUITY EQUATION FOR TWO-PHASE FLUIDS. Basso, Giuseppe (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 681-2 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2502 COMPARISON OF THE PROPAGATION CHARACTERISTICS OF COMPRESSION AND RAREFACTION PRESSURE PULSES IN TWO-PHASE, ONE-COMPONENT BUBBLE FLOW. Grolmes, M. A.; Fauske, H. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 683 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2503 TWO-PHASE FLOW THROUGH VARIABLE AREA DUCTS. Prins, Carel A.; Korstanje, Hugo P. (Technical Univ. of Delft, Netherlands). Trans. Amer. Nucl. Soc., 11: 683-4 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2504 AN INTEGRATED ANALYTICAL MODEL FOR THE EVALUATION OF TWO-PHASE FLOW STABILITY. Kjaer-Pedersen, Niels (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 652-3 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2505 A SYSTEMATIC COMPARISON OF DIFFERENT HYDRODYNAMICS MODELS. Grumbach, Rainer (OECD Halden, Norway). Trans. Amer. Nucl. Soc., 11: 653-4 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2506 REMARKS ABOUT THE "ONCE-THROUGH" PROBLEM. Cumo, Maurizio; Earello, Giovanni; Elvio; Palmieri, Angelo (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 654-5 (Nov. 1968).

2507 SYNTHESIS METHODS IN HEAT CONDUCTION. Del Bene, J. V. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 655-6 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2508 EXPERIMENTAL DETERMINATION AND ANALYSIS OF VIBRATIONS INDUCED BY FLOW NOISE IN TUBES. Addae, Andrew K.; Fenech, Henri (Masschusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 651 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2509 HEAT TRANSFER FROM SPHERES INTO SUBCOOLED LIQUID SODIUM DURING FORCED CONVECTION. Witte, L. C. (Univ. of Houston, Tex.); Baker, L. Jr.; Haworth, D. R. J. Heat Transfer, 90: 394-8 (Nov. 1968).

Heat transfer rates from ½-in. dia spheres were measured as the sphere moved through a pool of subcooled liquid sodium. Measurements were made at atmospheric pressure and with sodium at 572 and 842°F. Sphere temperatures ranged up to 3600°F. Heat transfer rates up to 3.6×10^7 Btu/hr sq ft were calculated from the experimental data. It was shown in this study that large amounts of subcooling in the liquid sodium and motion of the sphere tend to prevent the formation of vapor at the surface of high-temperature spheres. These experimental data were correlated by a theory in which it was assumed that highly superheated liquid sodium would be in contact with a high-temperature sphere. (auth)

2510 HEAT EXCHANGE ELEMENTS. Rigg, Shepherd; Brocklebank, Richard Bennett (to United Kingdom Atomic Energy Authority). British Patent 1,132,092. Oct. 30, 1968. Filed Sept. 9, 1965.

A method of arranging fuel rods for a compact fast reactor to keep the coolant volume fraction low in the core is described. The fuel rods acting as heat exchange elements are spaced so that the space between any element and the surrounding elements is defined by heat transfer surfaces forming a channel for the heat exchange medium. Airfoil shapes are attached to some of the rods to prevent lateral displacement. (F.S.)

2511 HEAT-TRANSFER PREDICTIONS IN THE COOLING PASSAGES OF NUCLEAR ROCKET NOZZLES. Taylor, Maynard F. (Lewis Research Center, Cleveland). J. Spacecraft Rockets, 5: 1353-5 (Nov. 1968).

Equations were developed for the prediction of heat transfer coefficients in straight and curved tubes. The success in predicting heat transfer in these tubes encouraged the use of the equations in predicting heat transfer coefficients in the coolant passages

of a nuclear rocket nozzle. It is not known how far the effects of curvature extend downstream of the point of tangency where a curved tube becomes straight. The curvature effect appears to be present at the last instrumented station or 2 dia downstream of the tangency point. (R.C.K.)

2512 TEPLOOTDACHA PUCHKOV TRUB V POPERECHNOM POTOKE ZHIDKOSTI. (Heat Transfer in Banks of Tubes in Cross-flow of Fluid). Zhukauskas, A. Vilnyus, USSR, Izdatel'stvo Mintis, 1968. 191p.

The results of extensive investigations on heat transfer and fluid friction in banks of tubes in cross-flow of fluids are presented. Experiments were performed on 27 banks of smooth tubes in in-line and staggered arrangements in cross-flows of air, transformer oil, and water. The experimental equipment and procedures are described. The effects of each of the variables, i.e., properties of the fluids, heat flux direction, arrangement of tubes, and other factors, on heat transfer and fluid friction are comprehensively summarized. Monograms for determining fluid friction in tube banks for in-line and staggered arrangements were derived from the experimental data. The heat transfer results agreed well with the results obtained by other experimenters. A number of formulas for determining heat transfer in banks of tubes are given. Problems of the effectiveness of heat transfer in a bank were also studied, and an analysis of the test results showed that closely spaced tube banks are most effective. (L.C.L.)

Isotope Technology

Refer also to abstracts 2237, 2483, 2490, 2536, 2537, 2567, 2568, 3166, and 3888.

2513 (ALO–3632-20) THERMAL INSULATION STUDY. Final Report. Phase I, March 28, 1966–September 27, 1967. DeWitt, W. D.; Gibbon, N. C.; Reid, R. L.; Webster, D. J. (Union Carbide Corp., [Tonawanda, N. Y.] Linde Div.). Nov. 14, 1967. Contract AT(30-1)-3632. 227p. Dep. CFSTI.

The object of this program was to evaluate, develop, and demonstrate thermal insulation systems for use in radioisotope power systems. The insulation systems investigated were of the multilayer type where highly reflective radiation shields separated by low thermal-conductivity spacers operate in a vacuum. Radiation shield material selections of aluminum, copper, and nickel based on previous work were verified and an operating temperature–design life trade off study based on loss of shield by vaporization was performed. As a result, the maximum operating temperature for any of the above foils of given thickness and design life has been determined. Tantalum foil had been considered for use at temperatures above the use temperature of nickel but was rejected due to observed incompatibility with silica fiber spacers. The fibrous spacers evaluated were glass fiber paper, aluminum flake opacified glass fiber paper, Refrasil quartz fiber paper, copper flake opacified Refrasil quartz fiber paper, and Astroquartz cloth. The thermal conductivity of six different spacer-shield combinations was determined as a function of temperature. The measured thermal conductivities ranged between 0.15 to 3.5×10^{-3} Btu/hr ft °R over the temperature range $T_{hot\ face}$ = 400°F to 1800°F and $T_{cold\ face}$ = 70°F. Three of the combinations were tested for 2000 hr with no thermal performance degradation. A fourth, tantalum foil-Astroquartz cloth, exhibited degradation due to the formation of high emissivity compounds of tantalum. A seventh, also a 2000 hr test is under way and will be completed in Phase II. An analytical study was made to determine the thermal effects of air exposure during ground hold conditions on multilayer insulations at operating temperatures and in vacuum. All three radiation shield materials, aluminum, copper, and nickel, are capable of some air exposure before deterioration of thermal conductivity in vacuum occurs. An analytical method was developed, and experimentally verified on copper, that will predict the thermal conductivity of insulation in vacuum after air exposure. An analytical study was made to assess the effect of various edge conditions on the thermal performance of multilayer insulation panels. The effects of panel width, gap width or angle between panels, panel thickness and exposed edges were investigated. The thermal conductivity of a panel ten inches wide, 0.2 in. thick with a gap of 0.050 in. would be about 1.5 times that of a panel without a gap. If metal flake opacified papers are used to fill the gap the panel thermal conductivity degradation is improved so that the thermal conductivity is less than 5% higher than for a similar panel with zero gap. The processing required to render the radiation shield foils and spacers physically and chemically stable at operating temperature in vacuum was determined. Low offgassing rates, below 0.1 μl/hr/ft² were measured for all materials at their respective operating temperatures, except Astroquartz cloth and Refrasil quartz fiber paper which exhibited this rate up to 1700°F. At 1800°F these materials exhibited offgassing rates of 1 to 3 μl/hr/ft². Offgas compositions were determined by mass spectrometer gas analysis and found to be predominantly hydrogen. A preliminary evaluation of the problems associated with the design and fabrication of high temperature vacuum enclosures was made. An Inconel-600 test specimen was fabricated and tested at 1800°F in a one side vacuum, one side air environment. Leakage developed after 300 hr with cause of failure attributed to oxidation penetration accelerated by the high stress level. A second specimen, Hastelloy-X, has successfully completed 4000 hr of testing at 1400°F with a vacuum on one side and air on the other. Material compatibility experiments to determine long-term compatibility of insulation materials with themselves and with vacuum enclosure materials in vacuum and at operating temperature were made. Tantalum foil and silica fibers were found to be incompatible. The resistance of five processed insulation combinations to vibration levels typical of service requirements was evaluated with no physical deterioration of any of the combinations observed by visual inspections. Physical and chemical tests were performed on the spacers in the "as received" and "after processed conditions" to determine their suitability for insulation application. All candidates possessed sufficient strength after processing for insulation application. Based on the results of this program the feasibility of using the multi-foil type of insulations on radioisotope power systems has been demonstrated. (auth)

2514 (ANL-Trans-677) INVESTIGATION OF THE DENSITY OF LIQUID Pb, Cs, AND Ga BY THE GAMMA METHOD. Basin, A. S.; Solov'ev, A. N. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Zh. Prikl. Mekh. Tekh. Fiz., No. 6, 83-7(1967). 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 21289. (R.C.K.)

2515 (ICRU–12) CERTIFICATION OF STANDARDIZED RADIOACTIVE SOURCES. (International Commission on Radiation Units and Measurements, Washington, D. C.). Sept. 15, 1968. 10p. ICRU Publications, Washington, D. C., $1.00.

A comprehensive list of information which should be provided with a standardized radiation source, including a description of purity and a statement of the precision by which the radioactivity was measured, is presented. (B.G.D.)

2516 (N–68-11871) STUDY AND PRELIMINARY DESIGN OF AN ISOTOPE-HEATED CATALYTIC OXIDIZER SYSTEM. Addendum I. Lamparter, Richard A. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). [1967]. Contract NAS1-6256. 57p. (NASA-CR–66497). CFSTI.

A study was performed to develop data on systems including pre- and postsorbent beds for 3, 6, and 9-man crew sizes. The basic study assumed the inlet gas stream to be free of compounds that might poison the catalyst. The contaminant load was evaluated to define potential catalyst poisons and compounds that might yield toxic products of combustion and sorbents were evaluated that might be used to remove these compounds. Activated charcoal and lithium hydroxide were found to comprise the optimum presorbent bed, and lithium hydroxide, the optimum postsorbent bed. The use of isotope and electric heat sources for life support systems was considered. Evaluation of the design shows that its configuration is near optimum for an electrically heated version with the exception of the provisions made for intact reentry. The 9-man pre- and postsorbent bed and catalytic oxidizer designs were combined into an integrated system. The favored installation for the system is downstream of the main activated charcoal bed in the Basic System Module (BSM) life support system, primarily to utilize this charcoal as a pre-sorber. (auth) (STAR)

2517 (N–68-25829) ANALYSIS AND SELECTION OF DESIGN CONDITIONS FOR A RADIOISOTOPE BRAYTON-CYCLE SPACE POWERPLANT. Klann, John L.; Soffer, Leonard; Barna, Gerald J.; Kaykaty, Gabriel N.; Kerwin, Paul T.; Bien, Darl D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). June 1968. 83p. (NASA-TN-D–4600). CFSTI.

Selections were made for a conceptual plutonium 238 module for electric powers in the range from 2 to 10 kilowatts. Based on the selections, component and system efficiency and weight were estimated for powers of 2, 6, and 10 kilowatts. (STAR)

2518 (NP–17597, pp 97-108) ARTIFICIAL RADIOELEMENTS, STABLE ISOTOPES, AND UTILIZATION OF RADIATION. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE —research activities on radioisotopes, stable isotopes, and radiation usage, 1967 summary of

RADIOISOTOPES, STABLE ISOTOPES—production in France, 1967 summary of
RADIATION—measurement techniques for, 1967 summary of French research on
RADIATION, RADIOISOTOPES—use in agriculture, industry, and medicine, 1967 summary of French research on (H.D.R.)

2519 (ORNL-4329) REVIEW OF RADIOISOTOPES PROGRAM 1967. Gillette, J. H. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 48p. Dep. CFSTI.

Radioisotope preparations including ^{69m}Zn, ^{43}K, ^{92m}Nb, ^{33}P, ^{67}Cu, ^{95m}Tc, and ^{123}I are discussed. The feasibility and economics of producing ^{171}Tm as an isotopic power heat source were investigated. The high neutron flux capabilities of the HFIR were determined in the beryllium reflector and the hydraulic tube positions. The thermal neutron cross section and resonance integral of ^{140}Ba were determined to be 1.57 ± 0.3 and 13.6 ± 1.4 barns, respectively, and the effective cross section of ^{204}Tl was determined to be 23.1 barns. Thermal diffusion enrichment of the ^{85}Kr in the fission-product krypton provided 240 Ci of 13.97% ^{85}Kr and 370 Ci of 27.62% ^{85}Kr. Field tests with ^{133}Xe-tagged sand were carried out to evaluate equipment and to develop more effective procedures for use in studying the direction, velocity, and volume of sand movement. Beta, low-energy γ, secondary x-ray, and neutron sources were developed, fabricated, and characterized for varied applications. The feasibility of producing ^{153}Gd in sufficient quantity and purity to be used for the Mars Atmosphere Density Sensor source was determined, and alternative radioisotope sources were investigated. An experimental blood irradiator was designed and fabricated using ^{90}Sr. An ^{55}Fe source was prepared for use in an x-ray diffractometer. Two types of radiographic cameras were designed and fabricated: one for use with ^{147}Pm and ^{169}Yb and the other for use with ^{241}Am and ^{57}Co. A process was developed for producing high intensity beta sources consisting of stainless steel capsules containing strontium silicate spheres embedded in an aluminum matrix. The reliability of radioactive source capsules used to contain radioactive materials and shipping containers used to transport radioactive materials was determined under conditions of normal use as well as in the event of an accident. An applications rating guide was developed to determine the required source classification for the intended application of a source and the expected environmental conditions experienced during its operating life. Tests were begun to determine if certain selected ORNL source capsules meet the USAEC requirements for "special form material." Test capsules made of 304L and 316L stainless steel, Inconel, and Hastelloy C were exposed to cesium chloride at 1300°C to determine their compatibility with cesium chloride under conditions which may exist in the event of a fire. A heat transfer study was performed on a Sugarman shipping cask in combination with the wood shield against fire and impact in which it will be shipped. (auth)

2520 (WANL-3800-21) SNAP-23A, PHASE 1. Quarterly Progress Report, June 1-August 31, 1968. Wilgus, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Sept. 30, 1968. Contract AT(30-1)-3800. 106p. (WANL-PR-SS-19). Dep. CFSTI.

Efforts devoted to reliability and systems design were concentrated on the modifications and assembly procedures necessary to rebuild the Experimental Mockup System (EMS) after failure. A layout of the instrumentation is given and the data to be monitored during EMS testing are tabulated. The design criteria to define a dual purpose shipping cask for the SNAP-23A heat source/biological shield assembly or the complete SNAP generator are given. A phase shift occurs during aging below 1100°F in the U-8 Mo shield. The source/shield assembly configurations are shown. Rain shield area insulation design, diffusion barrier design, heat source assembly heater design, and other design modifications are discussed. The modifications necessary for the electrical heater source assembly are determined. Capsule and components fabrication depends on weld joint configurations. Studies are in progress on welding variables. Cleaning procedures are explained for EMS components contaminated with cutting oils. Materials testing includes stress rupture testing of U-8 Mo, spherical insulation testing, and thermal conductivity measurements. Predicted dose rates for the shield assembly and bare capsule are tabulated. System testing in the base assembly revealed corrosion of the hermetically sealed instrumentation and power lead parts and heater circuit grounding in the heat source assembly. Safety of components is analyzed and the study of fuel containment in shallow and deep water continues. (J.C.W.)

2521 ARRANGEMENT FOR TREATING OBJECTS BY MEANS OF RADIOACTIVE RADIATION. Cless-Bernet, T. (to Osterreichische Studiengesellschaft fur Atomenergie). Canadian Patent 789,109. July 2, 1968. Priority date Nov. 28, 1963, Austria.

Apparatus is described for β-radiation treatment of powders, granules, thin objects as well as liquids and gases. The β-emitter such as ^{90}Sr or ^{90}Y are disposed in the wall of a tube or container of some other shape and material to be irradiated is moved past the dispersed radioactive source. Suitable shielding must be provided in the exterior wall. One variation mentioned is the use of β-emitter attached to a carrier of high atomic number thus causing an increase in the irradiation effect by back scattering and bremsstrahlung. Uniform dose is given as an advantage of the arrangement because the active substance encloses the material to be irradiated. (F.S.A.)

2522 THERAPEUTIC RADIOACTIVE SOURCE AND METHOD OF MANUFACTURE THEREFOR. Lawrence, Donald Conrad (to Hazleton-Nuclear Science Corp.). British Patent 1,133,219. Nov. 13, 1968. Filed Dec. 20, 1965.

An elongated tube containing a therapeutic radioactive x-ray emitting source of 20 to 100 keV and a half-life of 5 to 100 days is described. Suitable isotopes are ^{125}I, ^{131}Cs, and ^{103}Pd. The design to house each source is described. Referred to as a seed, the source is implanted in the tissue of the patient. (J.C.W.)

2523 GAMMA-RAY STATIONKEEPING SYSTEM FLOWN. Klass, Philip J. Aviat. Week Space Technol., 89: 55-8 (July 22, 1968).

The results of flight tests of an all-weather helicopter stationkeeping technique using radioisotope-generated γ rays are described. The technique may provide range and bearing data to other equipped helicopters in close formation out to distances of 600 or 1000 ft. The γ-ray beacons consist of a capsule containing ^{90}Sr intermixed with ^{238}U. The β rays emitted by the ^{90}Sr impinge on the ^{238}U which produces γ rays by the bremsstrahlung effect. The present beacons employ a 116-Ci source of ^{90}Sr. This is sufficient to require a special shield to protect the crew of the helicopter from radiation, especially when the beacon is mounted in the cargo compartment, but the intensity of the radiation received from the beacon by the crew of another helicopter flying in close formation is not hazardous. To protect personnel working on the breadboard equipment or the helicopter while it is on the ground, the radiation source is enclosed in a full shield, part of which can be opened manually once the helicopter is in flight. Both the health shield and the chopper are fabricated from depleted U whose external surfaces are Ni plated to suppress α-particle radiation. In an operational system, the shield would be operated remotely. The detector measures the bearing of the received γ rays and their intensity. The sensor for detecting the radiation from other helicopters consists of 4 tungsten-shielded scintillation counters, one for each azimuth quadrant. To identify the γ rays radiated by each equipped helicopter in the formation, each source is modulated at a preselected frequency by a motor-driven aperture which alternately shields and exposes the source. Statistical fluctuation could be reduced by using a more intense radioisotope source in the beacon, but this poses a radiological health problem. Another possibility is to increase the effective intercept area of the scintillation counters with a resultant increase in sensor size and its shielding weight. In an operational system the most likely choice of radioisotope appears to be ^{85}Kr. In the event of a crash the source would vent the ^{85}Kr to the air, allowing it to diffuse rapidly. (BBB)

2524 A TECHNIQUE FOR DEMONSTRATING C_{max} OF A PLUME USING A TRITIATED MOISTURE TRACER. Daly, J. C.; Sax, N. I.; Gabay, J. J. (New York State Dept. of Health, Albany). Trans. Amer. Nucl. Soc., 11: 469-70 (Nov. 1968).

2525 TESTS AND ANALYSES OF A BURIED HEAT SOURCE. Ruwe, Dean M.; Shaffer, Donald E. (Martin Marieta Corp., Baltimore). Trans. Amer. Nucl. Soc., 11: 428-9 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2526 A ^{147}Pm-FUELED MINIATURE THERMIONIC ELECTRICAL POWER SUPPLY. Gasper, K. A.; Andelin, R. L. (Donald W. Douglas Labs., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 429-30 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2527 PREPARATION OF ^{90}Sr SILICATE AND ITS FABRICATION INTO HIGH-INTENSITY BETA SOURCES. Case, F. N.; Mackey, T. S. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 455 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2528 ^{238}Pu ISOTOPIC POWER FUELS. Wittenberg, L. J.; Abrahamson, S. G. (Monsanto Chemical Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc., 11: 455-6 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2529 PRODUCTION OF BIOMEDICAL-GRADE ^{238}Pu. Hennelly, E. J. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc., 11: 456-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2530 A ^{137m}Ba GENERATOR. Kawashima, T. (Government Industrial Research Inst., Nagoya, Japan). Int. J. Appl. Radiat. Isotop., 19: 816-8(Nov. 1968).

Metastable ^{137}Ba, with a half-life of 2.60 min, emits a 0.66 MeV gamma ray and is utilized for several purposes: leak detection, the determination of flow distribution and of fluid-flow rates, milking and half-life demonstration experiments in the laboratory, and medical scanning. The ^{137m}Ba is the daughter nuclide of ^{137}Cs, which is a pure beta emitter with a half-life of 30 yr. The decay scheme of this pair of radionuclides is exceptionally useful in a milking system. A rapid procedure of milking is necessary to use ^{137m}Ba efficiently because of its short half-life. An investigation of the $^{137}Cs-^{137m}Ba$ generator system, undertaken in an effort to devise a simple manner of operation, to effect rapid milking, and to achieve high purification after repeated milkings is described. (auth)

2531 ON THE PROBLEM OF THE ACCURACY OF EXTRAPOLATION IN THE TRACER METHOD OF ACTIVITY DETERMINATION. Spanel, J. (Inst. for Research, Production, and Application of Radioisotopes, Prague). Int. J. Appl. Radiat. Isotop., 19: 818-20(Nov. 1968).

Williams (Int. J. Appl. Radiat. Isotop. 15: 709(1964)) arrived at some conclusions in respect to the accuracy of the tracer method in the case of application of linear extrapolation. These conclusions are discussed and amplified. (auth)

2532 IMPROVED X-RAY GAUGING APPARATUS. Hood, John Laurence Linsley (to Brisith Cellophane Ltd.). British Patent 1,131,143. Oct. 23, 1968. Filed Dec. 17, 1964.

An x-ray gaging apparatus is described which is used to determine the amount of an element or elements in a material such as a coating. The apparatus consists of an x-ray source which generates x rays which are absorbed by the element or elements and a detector for detecting the intensity of the x rays after they pass through the coating to determine the degree of absorption. The source is a β particle emitter such as ^{63}Ni or ^{35}S which does not emit γ radiation or internal conversion x rays in the presence of a gaseous target material. The target material may be tritium, argon or sulfur dioxide. (F.S.)

2533 RADIOACTIVE DEPLETED NATURAL URANIUM IRRADIATION SOURCE. Campbell, K. H. (to Canadian General Electric Co., Ltd.). Canadian Patent 789,110. July 2, 1968.

A method is described for using depleted fuel from a nuclear reactor after a burnup of 8,000 to 11,000 MWd/t U as a γ-radiation source to prolong the shelf life of certain foods or for sterilization of medical supplies. After storage for a short time to allow for decay of short lived highly radioactive fission products the fuel bundles are employed as γ-radiation sources either in containers or without. Amounts of γ-emitters available in a typical depleted fuel bundle are given. Three examples with supporting figures are quoted. (F.S.A.)

Materials Testing

Refer also to abstracts 2470, 2477, 2480, 2490, 2513, 2532, 2710, 2711, 3019, 3058, and 3167.

2534 (ORNL-IIC-16) USES OF NEUTRON RADIOGRAPHY. A Literature Review. Gerrard, Martha (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

The literature (~65 references) on neutron radiography is reviewed with special emphasis on uses and radioisotope sources. (auth)

2535 A STATIC SCANNING METHOD FOR NUCLEONIC COATING INSPECTION OF JET ENGINE TURBINE BLADES. Duftschmid, Klaus E. (General Nucleonics Div./Tyco, Claremont, Calif.). Trans. Amer. Nucl. Soc., 11: 467-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2536 NEUTRON RADIOGRAPHIC INSPECTION OF METAL ADHESIONS, ALLOYS, ACTIVE FUEL ELEMENTS, DIFFUSION OF H INTO Zr AND DIFFUSION H_2O-D_2O. Chountas, K.; Rauch, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 13: 444-8(Nov.-Dec. 1968). (In German).

Metal adhesions, alloys, active fuel elements, diffusion of H into Zr and the diffusion of light in heavy water were investigated by means of a new cone shaped collimator with thermal neutrons. The capacity of neutron radiography for the nondestructive testing of these materials and processes is demonstrated. The new method developed for the determination of the mean displacement of H-nuclei, can also be useful for investigations of chemical, osmotic and biological processes. (auth)

2537 IRRADIATION OF HOT INGOTS UP TO 250 mm THICK DURING INSPECTION FOR SHRINKAGE. Kuegler, Jorg (Vereins Deutscher Eisenhuettenleutte, Rheinhausen, Ger.). Stahl Eisen, 88: 21-31(Jan. 11, 1968). (In German).

An automatic installation is described, which uses ^{60}Co γ radiation to detect shrinkage cavities of >8 mm in ingots or blooms <250 mm thick, moving at speeds of 500 mm sec^{-1}. Calibration, location of probe head, and inspection of top or bottom of ingot can be controlled from the shear console. In order to calibrate and evaluate the display, 29 ingots were selected and examined in the cold state. Defect indications corresponded either to shrinkage cavities, or severe surface defects originating from hot-top refractories. The end of the defect display is within ±50 mm of the end of the defective length. A trial with reduced crop length and supervision of the cropped end by irradiation indicated a lower mean scrap-rate and increased scatter. (auth)

2538 DYNAMICS OF ELASTICALLY-CONNECTED RIGID BODIES SUBJECTED TO LARGE SUPPORT MOTIONS. Ved, Jamnadas Gokaldas. Stanford, Calif., Stanford Univ., 1968. 215p.

Thesis.

An investigation of the dynamic response of a system of rigid bodies connected by a space frame structure subjected to large support motions is described. The supports are assumed to move as a unit, and the deformations in the framing are assumed to be small and within the elastic range of the material. The equations of motion are derived in matrix form using Lagrange's form of D'Alembert's principle and the structural stiffness matrix. These equations are nonlinear, and the nonlinearity arises from the large rotations of the supports. A computer program was developed to generate the stiffness matrix of the structure and to solve the differential equations of motion by numerical integration. Numerical studies of several examples are presented in order to demonstrate applications of the method. In particular, the contribution of the nonlinear terms is studied for systems subjected to large rotations of the supports. Various positions of the axes of rotation with respect to mass centers of the bodies were studied. The feasibility of simplifying the analysis by linearizing the equations of motions was considered. Such simplifications proved to be reasonable for two of the examples studied. On the other hand, in a third example, the contribution of the nonlinear terms is found to be pronounced and hence linearization is not feasible. (Disser. Abstr.)

Protective Structures

2539 (ORNL-tr-2009) INSTRUCTIONS FOR A PUBLIC SHELTER. (Civilforsvarsstyrelsen (Denmark)). Translated for Oak Ridge National Lab., Tenn., from a Danish report. 40p. Dep. CFSTI.

The planning, cost, and design details of a public civil defense shelter for use in Denmark are described. (L.C.L.)

Radioactive Material Handling

Refer also to abstracts 2382, 2417, 2433, 2486, and 2519.

2540 (AERI-23) STUDIES ON INCINERATOR AIR CLEANING SYSTEM. Lee, Kwan; Lee, Sang Hoon; Kim, Duck Jin (Atomic Energy Research Inst., Seoul (South Korea)). [1968]. 26p. (SM-110/14; CONF-680811-9). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

A research project, undertaken to determine the efficiency of an incinerator and air cleaning system for the safe disposal of small institutional quantities of radioactive wastes, is described. The system consists of an oil burner incinerator with a tangential air supply and an air cleaning section. Air from the incinerator passes through a dilution air valve, a cyclone collector, a heat exchanger, a fiber glass filter, and an electrostatic precipitator. A series of tests, using ^{198}Au, ^{51}Cr, and ^{35}S as tracers, was performed to determine the decontamination capability of the air cleaning system. Several quantities of sawdust with equal total activities were incinerated, and the radioactivity of the flue gas measured. Sawdust with varying total activity was incinerated to

observe the influence of initial radioactivity on the activity of the flue gas. Data on the dust particles collected are given. It is concluded that the decontamination capability of the present incinerator and the gas cleaning system is sufficient for laboratories with small research reactors, and that the system is adequate even if the electrostatic precipitator is eliminated. (L.C.L.)

2541 (BNWL–820) STATUS OF TECHNOLOGY IN THE UNITED STATES FOR SOLIDIFICATION OF HIGHLY RADIOACTIVE LIQUID WASTES. Schneider, K. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 63p. Dep. CFSTI.

The current technological status in the U. S. on the solidification of highly radioactive wastes from the processing of spent power reactor fuels is presented. The four primary processes under development, i.e., spray solidification, phosphate glass solidification, pot calcination, and fluidized bed calcination, are summarized. Other processes, including those under development in Europe and Russia, are tabulated. Fully radioactive pilot plant tests have been in progress in the Waste Solidification Engineering Prototypes (WSEP) for the spray, phosphate glass, and pot solidification processes since November 1966. Large scale demonstrations with intermediate level wastes have been underway at the Waste Calcining Facility (WCF) using the fluidized bed calcination process since December 1963. Since start of major research and development 13 years ago, the technology has progressed to the point that commercial application for small Purex fuel processing plants (approximately one ton/day of fuel) is available immediately for the pot calcination process, and should be available for the other three processes in about one year. Technology for larger plants will be available two to three years after scale-up development (not now in progress) is initiated. Technical incentives for solidification of highly radioactive wastes before ultimate storage are presented, and characteristics of the various solidified waste products are summarized. (auth)

2542 (EUR–4047) DEVELOPMENT OF A METHOD OF CONCENTRATING AND DRYING LIQUID RADIOACTIVE WASTE AT LOW TEMPERATURES AND SMALL TEMPERATURE DIFFERENTIALS. Jessnitzer, K.; Lehmann, H. J. (Leybold-Heraeus G.m.b.H., Cologne (West Germany)). Sept. 1968. Contract 009-65-2 WASD. 70p. (In German). Dep.

The development of a method of treating radioactive liquid wastes by the freeze drying technique is described. The aim is to obtain a dry storable concentrate and a liquid or gaseous residue with a decontamination factor of at least 10^5. The process, including the evaporation, freezing, and freeze drying operations, is being tested in an experimental plant with a flow rate of about 25 l/hr feed to the evaporator. Work is still continuing on the development of the process. Preliminary concentration takes place in an evaporator adapted to operation at low temperatures and steam pressures. The principle of the trickle film evaporator was chosen, an apparatus was developed and studies were carried out which indicated optimum operation at evaporating temperatures of 30 to 40°C and temperature differentials of 6 to 8°C. The freezing of the preconcentrate (150 to 200 g/l) is described in detail, since the composition of the frozen solution decisively influences the energy required for the freeze drying and the throughflow. The properties of various methods chosen are studied. For the actual freeze drying stage a standard commercial laboratory plant was constructed for active operation. This plant can carry out various heating programs and also measure temperature and weight loss of the ice. Preliminary tests showed that it was possible to adapt various freezing techniques to a specific drying technique. (auth)

2543 (ORNL-TM–2369) BRIEF INVESTIGATION OF RADIOIODINE BEHAVIOR IN OFF-GAS SYSTEM OF TRU FACILITY (APRIL–AUGUST 1968). Adams, R. E.; Ackley, R. D.; Bennett, R. L. (Oak Ridge National Lab., Tenn.). Sept. 24, 1968. Contract W-7405-eng-26. 14p. Dep. CFSTI.

During processing operations in the Transuranium Processing Plant (TRU), ^{131}I has penetrated the iodine removal system which includes a 1-in. depth of iodized charcoal. This problem has been briefly investigated by observing, in the laboratory, the effects of certain processing agents on radioiodine trapping by iodized charcoal and by sampling and analyzing TRU off-gas. The laboratory tests showed that the vapors of diethylbenzene, Amsco 125-82, and hydrochloric acid individually could be very detrimental with respect to trapping $CH_3{}^{131}I$ by iodized charcoal. In I_2 trapping, HCl vapor again is harmful but not to as great an extent as is observed with $CH_3{}^{131}I$. Sampling of the off-gas system, at a point downstream of the caustic scrubber and upstream of the charcoal adsorber, was performed during one phase of the processing operation in an effort to obtain information relative to the chemical form of the iodine. The honeycomb iodine sampler, exposed over a 16 day period, produced data which indicated that the iodine radioactivity was about equally distributed between a form somewhat similar in chemical reactivity to elemental iodine and a form similar to methyl iodide. (auth)

2544 (ORNL-tr–1809) THE SHIPPING OF RADIOACTIVE MATERIALS AND SAFETY. Sousselier, Y. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Energ. Nucl. (Paris), 9: 266-8(1967). 7p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 299. (R.C.K.)

2545 DEVELOPMENT OF A PROCESS FOR INCORPORATION OF RADIOACTIVE WASTE SOLUTIONS AND SLURRIES IN EMULSIFIED ASPHALT. Godbee, Herschel W.; Goode, Jerry H.; Blanco, Raymond E. (Oak Ridge National Lab., Tenn.). Environ. Sci. Technol., 2: 1034-40(Nov. 1968).

Incorporation in asphalt is a promising method for preparing alkaline solutions and slurries of intermediate-level radioactive wastes for storage or burial. The wastes are mixed with an asphalt-water emulsion, the water is volatilized by heating the mixture to 160°C, and the residue containing the radioactive solids is drained into the final disposal container. The volume of waste to be stored is reduced by a factor of about 2. Products containing 60 wt % waste solids were homogeneous and showed satisfactorily low leach rates in water. The fraction of radionuclides leached through a specific surface per day was about 4×10^{-4} and 4×10^{-6} (sq cm per gram)$^{-1}$ day^{-1}, respectively, for soluble and insoluble radionuclides, with no significant increase at radiation (external ^{60}Co) doses as high as 10^9 RADs. The rate for the soluble nuclide cesium was about one tenth of that, when the cesium was sorbed on grundite clay. No evolution of gases or swelling was observed in products that contained up to 52 curies per gallon at radiation doses up to 1×10^8 RADs. (auth)

2546 STRAHLENSCHUTZPRAXIS. TEIL III. UMGANG MIT STRAHLERN. (Radiation Protection Techniques. Part III. Handling Radiation Sources). Oberhofer, Martin. Thiemig-Taschenbuecher. Band 14. Muenchen, Verlag Karl Thiemig KG, 1968. 315p. DM 19,80.

In the literature on radiation protection there are no directions as to how the fundamental standards, guidelines, and ordinances of radiation protection and the operational, institutional, and labor regulations can be fulfilled. A compilation of currently used protection and operational methods is presented. Those occurrences in connection with the handling of radiation sources which are often overlooked in spite of being self-evident and simple, and which lead to radiation exposures are discussed. The typical accidents and incidents are described, and risk evaluations are made for these. (tr-auth)

2547 RADIOACTIVE WASTE LOCATION VIA INFRARED SCANNING TECHNIQUES. Jensen, J. D. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 449-50 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2548 ON THE UTILIZATION OF CAVITIES IN SALT FORMATIONS FOR THE FINAL DISPOSAL OF RADIOACTIVE WASTES IN THE G.D.R. Richter, D.; Fulda, D.; Schwandt, A. (Staatliche Zentrale fuer Strahlenschutz, Erfurt, Ger.). Kernenergie, 11: 241-4(Sept. 1968). (In German).

The storage of radioactive wastes in salt formation cavities is a convenient method of the final disposal of such wastes. A general evaluation is presented and a review made of the possibilities for utilizing salt mines and salt cavities for this purpose in the G.D.R.. Safety problems are briefly discussed. (auth)

2549 SPENT FUEL SHIPPING CASK (Engineering Materials). (North American Aviation, Inc., Downey, Calif.). (CAPE–1787).

26 drawings.

A seven-element cask for shipping spent fuel elements from HNPF to the Savannah River Plant by railroad is described. The cask meets the requirements of AEC regulations and acceptance criteria of the Savannah River Plant. The cask system consists of a fuel bundle canister, cask, cradle, cask yoke and cradle lifting sling. The stainless steel fuel canister is 5 in. 00 tubing with 0.120 in. wall, and 16 ft 3 in. long. The cask, which is 17 ft 7½ in. long, consists of a carbon steel shell 41 in. OD and an inner stainless steel shell 22 ¾ in. ID. The cavity between the shells is filled with lead. The cradle supports the cask in a horizontal position for shipping and/or storage. The yoke is used to pick up the cask and place it in a vertical position. The 4-leg bridle sling is picked up by the crane hook and each leg is attached to one of the pad eyes on the cradle. (For details see TID-4100 Suppl. 49) (See also 22: 45266) (F.S.)

2550 REMOTE HANDLING MANIPULATOR. Walischmiller, Hans. British Patent 1,135,004. Nov. 27, 1968. Priority date Aug. 27, 1966, Germany.

A remote handling manipulator to be used in a hot cell or at any place that the operator cannot enter is described. The manipulator consists of a hollow beam which passes through the wall of the enclosure and contains the transmission devices. Both the master and the slave arms are divided by pivotal joints into upper and lower sections. The slave arm is connected to the beam in the vicinity of the wall and the lower arm section can pivot inwardly eliminating places in the hot cell that cannot be served by the manipulator. (F.S.)

Vacuum Engineering

2551 SMALL MERCURY-VAPOR DIFFUSION PUMP FOR OBTAINING ULTRAHIGH VACUUM. Rybalko, V. F.; Fogel, Ya. M.; Tatus, V. I.; Granovskii, V. G. (Inst. of Physical-Technical, Kharkov). Prib. Tekh. Eksp., No. 4, 159-60 (July-Aug. 1968). (In Russian).

An all-metal mercury-vapor pump used for obtaining an ultrahigh vacuum is described. The pump can obtain a vacuum better than 1×10^{-10} torr after 3 to 4 hours. The pumping speed is 50 l/sec in the pressure range 1×10^{-6} to 1×10^{-9} torr. (tr-auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 2288, 2290, and 3872.

2552 (CEA-R-3540) OPEN-AIR IONISATION CHAMBERS WITH WALLS OF SOFT-TISSUE EQUIVALENT MATERIAL FOR MEASURING PHOTON DOSES. Vialettes, Henry; Anceau, Jean-Claude; Grand, Michel; Petit, Gerard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1968. 31p. (In French). Dep.

The ionization chambers presented constitute a contribution to research into methods of carrying out correct determinations in the field of health physics. The use of a mixture of teflon containing 42.5 percent by weight of carbon for the chamber walls makes it possible to measure directly the dose absorbed in air through 300 mg/cm^2 of soft tissue and, consequently, the dose absorbed in the soft tissues with a maximum error of 10 percent for photon energies of between 10 keV and 10 MeV. Furthermore, since this material does not contain hydrogen, the chamber has a sensitivity to neutrons which is much less than other chambers in current use. Finally the shape of these chambers has been studied with a view to obtaining a satisfactory measurement from the isotropy point of view; for example for γ radiation of 27 keV, the 3-liter chamber is isotropic to within 10 percent over 270°, and the 12-liter chamber is isotropic to within 10 percent over 300°; for 1.25-MeV γ radiation this range is extended over 330° for the 3-liter chamber, and 360° for the 12-liter chamber. This report presents the measurements carried out with these chambers as well as the results obtained. These results are then compared to those obtained with other chambers currently used in the field of health physics. (auth)

2553 (EUR-3947) STABILIZATION OF A SAMPLING OSCILLOGRAPH BY WAVE FORM MEASUREMENTS. Cottini, C.; Gatti, E.; Lepre, G.; Svelto, V. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sept. 1968. Contract 186-66-1 ISPI. 24p. (In Italian). Dep.

A method of stabilizing the gain and drift of a sampling oscillograph is described. The method is used in the accurate measurement of fast wave forms, such as those originating from scintillation detectors. The method has been used, in particular, for the measurement of current impulses produced by scintillation detectors following excitation by various types of radiation, such as neutron and gamma radiation. Such results are used in the designing of event discriminators. (auth)

2554 (EUR-4046) STUDIES ON THE TECHNICAL FEASIBILITY AND CONDITIONS FOR THE CONSTRUCTION OF A GAMMA RADIATION DETECTOR FOR HIGH AMBIENT TEMPERATURES. Schmidt, K. (Internationale Atomreaktorbau G.m.b.H., Bensberg (West Germany)). Jan. 9, 1968. 86p. (In German). Dep.

An investigation was conducted into the technical feasibility of and conditions for the construction of an ionization chamber with a 10^{-11} A/mR/hr sensitivity for a 500°C ambient temperature and theoretical consideration given to the question of the contribution of the electrode material and the filler gap to the ionization chamber current. The findings were that with soft gamma radiation the type of electrode material and filler gas have an influence on the magnitude of the current. With hard gamma radiation, on the other hand, such as that emitted by ^{60}Co, for instance, no noteworthy contribution is seen to be made by the electrode material, the only factors here being the type and pressure of the filler gas. In addition, the chamber geometry effects (arrangement and/or number of electrodes) were assessed. The experimental research into suitable electrical insulating materials showed that at 500°C 20th Century B 2 aluminium oxide ceramic had a better insulance value than 10^{10} ohms, so that for an ionization chamber an insulance of better than 10^9 ohms is to be expected. The experimental research into the contribution of the electrode material and the filler gas to the ionization chamber current bore out the theoretical considerations to the effect that in the case of soft gamma radiation an appreciable gain in current can be obtained by judicious selection of the electrode material and filler gas, and that in the case of hard gamma radiation the sensitivity of an ionization chamber can only be stepped up by varying the type and pressure of the filler gases. On the basis of the results obtained in the preliminary investigations, an ionization chamber prototype was designed and constructed which fulfilled expectations in every respect. The target sensitivity of 1.3×10^{-11} A/mR/hr was achieved and the insulance of the ionization chamber prototype at 500°C is greater than 10^9 ohms. (auth)

2555 (EUR-4066) RAPID AND SIMPLE METHODS FOR THE MEASUREMENT OF BETA-GAMMA RADIOACTIVITY IN BIOLOGICAL SAMPLES. Giubileo, M.; Camera, V. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). June 18, 1968. 11p. (In Italian). Dep.

The systematic health supervision of workers exposed to radioactive contamination in a nuclear research center is difficult due to the multiplicity of radionuclides in the samples. The medical service of the JRC-Ispra has recently introduced a system which can reveal the presence of beta-gamma radioactivity in all types of biological samples by means of only 3 measurements: liquid scintillation counting for beta emitters with an energy inferior to 1 MeV, measurement of the Cherenkov effect for betas with an energy above 1 MeV, and gamma spectrometry. The time saving is considerable with the preliminary treatment reduced to a minimum, and certain errors due to chemical separations are avoided. The sensitivity is such that contaminations within the maximal permissible limits can be revealed. At the same time the methods are applicable even to accidents involving exposure to radionuclides. The principal advantage is that only 2 instruments are necessary to satisfy the demands of routine and cases of emergency. After an outline of the criteria adopted for the radiotoxicological surveillance of the personnel, the procedures actually in use in the systematic checks and in case of accident are described. (auth)

2556 (ISS-68/18) PARTICLE LOCALIZATION IN HIGHLY ABSORBING SCINTILLATORS. Cortellessa, G. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). June 5, 1968. 14p. Dep.

The possibility of localizing the position of a scintillation in a scintillator by comparing the light output from different sides of the scintillator itself is studied. The capabilities of the method are discussed for the scintillator NE 111 that has a particularly short absorption path. In a simplified case it is shown that it is possible to localize the scintillation with an error of few millimeters. (auth)

2557 (KURRI-TR-23) CHARACTERISTICS TEST OF KUR RADIATION MONITORS. 1. WATER RADIATION MONITORS. Katsurayama, Kosuke; Hayashi, Fumikazu; Sumino, Teruie; Yoshii, Giichi; Matsuda, Yoshihiro; Negoro, Akihiko; Tsujimoto, Tadashi; Saito, Masahiro; Sekiya, Koichi (Kyoto Univ. (Japan). Research Reactor Inst.). [nd]. 14p. (In Japanese and English). Dep.

Water radiation monitors installed in Research Reactor Institute, Kyoto University, have been calibrated for their sensitivity. A solution of commercially available potassium chloride containing natural ^{40}K was used as the standard for calibration. Results show that all water radiation monitors except the one for the storage tank have the ability to detect sufficiently small quantities of radioactivities. (auth)

2558 (KURRI-TR-27) MEASUREMENT OF FAST NEUTRON SPECTRA BY THRESHOLD DETECTORS. Kimura, Itsuro; Kobayashi, Katsuhei; (and others) (Kyoto Univ. (Japan). Research Reactor Inst.). 1967. 35p. (In Japanese and English). Dep.

Methods of measurement of the fast neutron spectra, using threshold reaction foils, are first reviewed, and then a procedure is proposed of expanding the unknown spectrum by the associated Laguerre polynomials with the experimental formula for fission spectrum as the first term. Then, it is calculated how the nuclear fission spectra and the four transformed spectra, using ^{115}In(n,n'), ^{32}S(n,p), ^{58}Ni(n,p), ^{27}Al(n,α), ^{27}Al(n,p), ^{24}Mg(n,p), ^{56}Fe(n,p), can be reproduced. It was shown that the Laguerre polynomials expansion method is far superior to the other methods. Finally, using the procedure, the fast neutron spectrum in the E-3 experimental hole of the Kyoto Univ. Reactor is obtained and compared with other methods. (auth)

2559 (LA-DC-9611) TESTS OF SIX HIGH TEMPERATURE NEUTRON DETECTORS TO 650°C. Bacastow, J. L.; Swickard, E. O. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 6p. (CONF-681017-1). Dep. CFSTI.

From 15th Nuclear Science Symposium, Montreal, Canada.

Two neutron detectors (fission counters) from each of three manufacturers were tested at several temperatures between ambient and 650°C. Parameters examined as a function of temperature were: pulse height distribution, noise vs. voltage, capacitance, and leakage current. (auth)

2560 (ORO-2401-25) EXPERIMENTAL EVALUATION OF MOTION CHARACTERISTICS OF A SCANNER TRANSPORT SYS-

TEM. Erickson, J.; Kramer, C.; Watts, J.; Wallace, J. (Vanderbilt Univ., Nashville, Tenn. School of Medicine). Oct. 15, 1968. 29p. Dep. CFSTI.

Analysis of a two-crystal rectilinear radioisotope scanner constructed in a low-level counting facility was performed using three independent methods. The results of each analysis are discussed separately and a comparison presented. The first type of analysis was carried out by measuring the transients on acceleration from rest with the scanner by use of a tachometer attached to judicially chosen points on the scanner. The second method of analysis employed an optical lever system and provided a semiquantitative measurement of the magnitude of steady state oscillations. (B.G.D.)

2561 (UR-875-255) DATA ON CHERENKOV COUNTERS. Melissinos, A. C.; Stinson, W. J. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Sept. 5, 1968. Contract AT(30-1)-875. 32p. Dep. CFSTI.

Data on specifications, assembly, drawings, and operational data are presented on five different Cherenkov detectors. These include 4-inch, 12-inch, and 42-inch low-pressure gas threshold detectors, a 5-inch high pressure gas differential detector, and a 4-inch liquid radiator differential detector. (B.G.D.)

2562 ON THE DETECTION OF 1-keV EVENTS IN NaI(Tl). McCann, M. F.; Smith, K. M. (Glasgow Univ.). Nucl. Instrum. Methods, 65: 173-7(Nov. 1, 1968).

The observation of the 0.87 keV ^{22}Na K capture peak, and the 1 keV ^{65}Zn L capture peak, using internal sources in NaI(Tl) is reported. The relevance of these measurements both to the low energy scintillation response of NaI(Tl), and to the effect of included sources on the scintillator is discussed. (auth)

2563 IMPROVEMENTS RELATING TO THE COUNTING OF NEUTRONS. Romano, Fulvio (to Commissariat a l'Energie Atomique). British Patent 1,132,932. Nov. 6, 1968. Priority date May 25, 1966, France.

A neutron detector having a gas-filled chamber and at least one electrode made of a material having a large neutron cross section such that when the material is activated by neutrons beta or gamma radiation emitted will ionize the gas and a current can be measured. (B.G.D.)

2564 WHOLE-BODY RADIOACTIVITY MEASUREMENT IN MEDICAL RESEARCH AND CLINICAL DIAGNOSIS. Heinrich, H. C. (Univ., Hamburg). Therapiewoche, 17: 2099-2121(Dec. 20, 1967). (In German).

A bibliographic review is given of the construction and applicability of the 4-π radiation detector with liquid organic scintillator, in operation in Hamburg since the spring of 1962. The design and sensitivity of the whole-body counter are discussed. The applicability of the whole-body counter to the measurement of whole-body retention and excretion measurements is described. Results obtained in the measurement of the whole-body metabolism of iodine are reported. Resorption and whole-body metabolism of iron, vitamin B_{12}, ^{131}I-labeled polyvinylpyrrolidinone, and metalloorganic Hg compounds were also studied, and the results are summarized. (J.S.R.)

2565 NOTES ON THE PEAK-TROUGH RATIO OF LITHIUM-GLASS SCINTILLATORS. Fritzsch, E. (Physikalische Institut der Bergakademie, Freiberg). Kernenergie, 11: 239-40(Sept. 1968). (In German).

It is shown that the maximum peak/trough ratio of lithium glass scintillators is a measure of the figure of merit of the measuring head and that the peak/trough ratio measured in a neutron-gamma field is essentially dependent on the gamma-radiation. A method is proposed for determining the maximum peak/trough ratio. (auth)

2566 NEW METHOD OF DISCRIMINATION OF COSMIC ION TRACKS IN EMULSIONS. Fernandez, F. (Facultad de Ciencias, Sevilla, Spain); Vazquez, J. Casas; Villar, V. Perez; Gandia, V.; Kaiser, R.; Aiguabella, R.; Schmitt, R. An. Fis., 64: 235-41(July-Aug. 1968). (In Spanish).

Gap length and blob density measurements were carried out over proton tracks in gradually sensitized Ilford K0-K5 and K2-K5 emulsions. O'Ceallaigh's law is shown to hold and its parameter at the equivalent proton ranges for Z = 3, 4, and 5 ions is estimated. Possibilities of discrimination for cosmic light ions are discussed. (auth)

2567 SOME ASPECTS OF RADIOACTIVITY STANDARDIZATION AT THE CBNM OF EURATOM. Spernol, A. (EURATOM, Geel, Belgium). Trans. Amer. Nucl. Soc., 11: 465(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2568 INTERNATIONAL COMPARISONS OF CALIBRATED RADIONUCLIDE SOURCES. Rytz, A. (Bureau International des poids et Mesures, Sevres, France). Trans. Amer. Nucl. Soc., 11: 465-6(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2569 CALIBRATION PROCEDURES FOR RADIATION MEASUREMENTS. Motz, J. W. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 460(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2570 EPITHERMAL-NEUTRON SPECTRUM MEASUREMENT USING A PLURAL FOIL. Grashuis, J. L.; Dekker, A. L.; Kleijn, H. R. (Univ. of Delft, Netherlands). Trans. Amer. Nucl. Soc., 11: 637(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2571 HIGH-EFFICIENCY NEUTRON DETECTORS FOR NUCLEAR SAFEGUARDS APPLICATIONS. East, L. V.; Walton, R. B. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 636-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2572 ELECTRONIC SYSTEM DEVELOPMENTS FOR PROTON RECOIL SPECTRA MEASUREMENTS IN PLUTONIUM CRITICAL FACILITIES. Larson, J. M.; Powell, J. E. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 635-6(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2573 ON THE USE OF IONIZATION-CHAMBER NEUTRON DETECTORS FOR KINETIC MEASUREMENTS IN INTENSE TRANSIENT GAMMA FIELDS. Gozani, T. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 634-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2574 SOLID STATE DETECTORS AND THEIR FABRICATION. Hussain, Muhtasham (Dacca Univ., Pakistan); Dutt, J. C.; Khondker, Nurannabi; Molla, N. I. Nucl. Sci. Appl., 4: 34-41 (Apr. 1968).

Properties and principles of semiconductor detectors are discussed. The procedure adopted at the Atomic Energy Center, Dacca, for fabricating surface-barrier detectors from n-type silicon crystals is described in details. The method is based on that of Dearnaley of Harwell. A success rate of about 50% was reached with detectors having the energy resolution (fwhm) between 0.66 and 1.30% for 5.47-MeV alpha particles. (auth)

2575 AIR IONIZATION CHAMBER FOR γ-RADIATION STANDARDIZATION. Klumpar, Josef; Jirousek, Pavel (Ustavu Jaderneho Vyskumu, Prague). Jad. Energ., 14: 393-5(1968). (In Czech).

Air ionization chamber used for absolute standardization of ^{60}Co and ^{137}Cs γ-radiation is described. The chamber operates at 20 atm pressure and 40 kV. By shifting the measuring system (of 40 × 40 × 100 cm) inside the pressure vessel it was possible to record γ-absorption in the air. (tr-auth)

2576 TOMOGRAPHIC GAMMA RAY SCANNER (Engineering Materials). (California Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1783).

25 drawings.

A new type of radioisotope scanner with high sensitivity in combination with high resolution over a wide range of depths is described. The scanner provides a tomographic series of pictures in which the depth of a lesion in a thick organ such as the liver or brain is indicated by the picture in the series which shows the lesion with the sharpest resolution. The instrument consists of a γ-ray image detector similar to that used in radioisotope cameras except that the seven NaI crystals are thicker, a focused collimator, a system for displaying scintillations that occur in the image detector as point flashes of light on a cathode-ray tube screen, and either a special optical readout camera or a computer memory system for storing and displaying the pictures. (For details see TID-4100 Suppl. 48) (F.S.)

2577 SEMICONDUCTOR-DETECTOR HAVING A LITHIUM COMPENSATED SHELF REGION BETWEEN OPPOSITE CONDUCTIVITY TYPE REGIONS. Goulding, Frederick S.; Lothrop, Robert P. (to United States Atomic Energy Commission). U. S. Patent 3,413,529. Nov. 26, 1968.

A thick semiconductor for detecting charged particle radiation and gamma rays, and having means for greatly reducing surface

currents, to thereby increase the signal to noise ratio is described. A thin annular surface region encircles one of the contact terminals and separates the contact terminals of the semiconductor. Nearly the entire applied voltage is impressed transversely across the thin region, depleting the surface of all charge carriers and preventing surface currents. (AEC)

2578 LITHIUM DRIFTED SEMICONDUCTOR RADIATION DETECTOR. Llacer, J. (to United States Atomic Energy Commission). U. S. Patent 3,413,528. Nov. 26, 1968.

A method of producing a lithium-drifted semiconductor radiation detector by cutting a groove having a U-shaped cross section defining a closed figure in one face of the detector is presented. (AEC)

2579 A SENSITIVE, LOW BACKGROUND DETECTOR FOR RADIO GAS–LIQUID CHROMATOGRAPHY. Simpson, T. H. (Marine Lab., Aberdeen, Scotland). J. Chromatogr., 38: 24-34 (Nov. 5, 1968).

The design of a novel detector assembly for radio gas–liquid chromatography is described. The assembly comprises a gas flow proportional counter, plastic phosphor anti-coincidence guard counter and graded gamma shield. The net background count rate is 1.01 cpm. The operational advantages of low background detector systems are discussed and the merits of digital display of counting information described. (auth)

2580 LIQUID SCINTILLATION ANALYSIS: COMPUTER PROCESSING. O'Toole, J. J.; Osburn, J. O. (Veterans Administration Hospital, Iowa City, Iowa). Int. J. Appl. Radiat. Isotop., 19: 821-2(Nov. 1968).

A number of computer programs have appeared for the analysis of dual mixtures of beta emitting nuclides in liquid-scintillation counting. Some programs have employed the internal-standard technique, while at least two programs are available for use with automatic external standardization. A program tailored for two-channel use in an instrument using automatic external standardization capable of reporting raw data as counts per minute minus background is described. (auth) (UK)

2581 LUMINESCENCE INCREASE IN LIQUID SCINTILLATORS BY ELECTRIC FIELDS. Schmidt, H. (Institut fuer Angewandte Isotopenforschung, Berlin). Int. J. Appl. Radiat. Isotop., 19: 801-3(Nov. 1968). (In German).

The relative physical efficiency of a liquid scintillator is increased by applying an electric field to the scintillator volume. Excitation of the scintillator was performed by means of Gd-153 radiation. The effect has not yet been explained. The influence of the electric field both on the energy levels of molecules and on energy transfer, regarding the scintillating solutions as a coupled system of solvent and scintillator molecules, might give an explanation. (auth) (UK)

2582 EVALUATION OF THE SAMPLE ROTATION METHOD FOR FAECAL GAMMA RAY ASSAY. Buchan, R. C. T. (Plymouth General Hospital, Engl.). Int. J. Appl. Radiat. Isotop., 19: 807-11(Nov. 1968).

There is a need in some isotope laboratories for a simple and inexpensive gamma ray counting system having a sample volume in the region of 500 to 1000 ml and possessing a good degree of uniformity of response both with regard to degree of dilution and heterogeneity of distribution of the radioisotope within that volume. Such a system is particularly necessary for the accurate assay of such isotopes as chromium-51 and iron-59 in faeces in the form of samples inside unopened disposable waxed cardboard containers. An apparently little used method of achieving the large sample volume requirement is that of sample rotation. Attention is drawn to the sample rotation principle of Dratz and Coberley (Gastroenterology 41: 380(1961)), and the results of an experimental evaluation are presented. (auth)

2583 A SIMPLIFIED METHOD OF PREPARING THIN CONDUCTIVE FILMS FOR 4 PI COUNTING. Phillips, C. R.; Kauffman, P. (National Center for Radiological Health, Winchester, Mass.). Int. J. Appl. Radiat. Isotop., 19: 811-12(Nov. 1968).

Thin conductive films, of the order of micrograms per square centimeter, are useful in four pi beta counting, and the preparation of such films from VYNS (polyvinylchloride-acetate copolymer) has been described. These films exhibit most of the characteristics desired for their use, such as acid resistance, mechanical strength, ease of formation in thin (<10 $\mu g/cm^2$) film, etc. In order to make these films conductive, a thin metallic layer (usually gold) is vacuum evaporated onto the film. It was desired to develop a film preparation procedure which would be simple, reproducible and avoid the necessity of purchasing rather expensive vacuum evaporation apparatus. It was found possible to produce a thin VYNS film, rendered conductive with a carbon film, in two operations, using a procedure similar to that reported by Viola and O'Connell (Nucl. Intr. Neth. 32: 125(1965)). (auth) (UK)

2584 THE CALIBRATION OF THE 1383A IONIZATION CHAMBER FOR ^{87m}Sr. Goodier, I. W.; Hughes, F. H.; Woods, M. J. (National Physical Lab., Teddington, Engl.). Int. J. Appl. Radiat. Isotop., 19: 795-7(Nov. 1968).

The standardization of ^{87m}Sr was carried out, giving a calibration figure of 9.75 ± 0.15pA/mCi for the N.P.L. standard 1383A ionization chamber used without liner and a value of 0.212 ± 0.002 for the total internal conversion coefficient of the 388 keV gamma ray. The half-life of ^{87m}Sr was measured as 2.805 ± 0.003 hr. (auth) (UK)

2585 APPARATUS FOR INVESTIGATING THE SPECTRUM-KINETIC CHARACTERISTICS OF LUMINESCENCE UPON ELECTRON-EXCITATION. Aluker, E. D.; Tomkus, I. S.; Chernov, S. A. (Inst. of Physics, Riga). Prib. Tekh. Eksp., No. 4, 184-6 (July-Aug. 1968). (In Russian).

A device for simulating the ionization processes which occur in scintillators after electron excitation is proposed. The apparatus, which uses a welding electron source permits measurement of the emission spectra and pulse shape from scintillators after electron-excitation at 2 to 100 μseconds with energies up to 20 keV and currents up to 100 mA. (tr-auth)

2586 LUMINESCENCE YIELD OF NaI-BASED SCINTILLATORS. Globus, M. E.; Ratner, A. M.; Tsirlin, Yu. A. (All-Union Scientific Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 4, 67-8 (July-Aug. 1968). (In Russian).

The light-gathering coefficient τ, which contrasts the technical and physical luminescence, was examined. The dependence of τ on the geometric parameters of a scintillator with a diffusely reflecting surface and on the absorption coefficient of the scintillator substance was calculated. The inadvisability of increasing the dimensions of the scintillator beyond certain limits was shown. (tr-auth)

2587 METHOD FOR THE DETERMINATION OF OPTICAL SPECTRA OF SCINTILLATIONS. Volkov, N. G.; Ivanov, G. V.; Lyapidevskii, V. K.; Obodovskii, I. M. (Inst. of Engineering and Physics, Moscow). Prib. Tekh. Eksp., No. 4, 65-6 (July-Aug. 1968). (In Russian).

A method for the determination of optical spectra by measuring the intensities of luminescence with different filters is described. The method also utilizes an equation which relates intensity with spectra. (tr-auth)

2588 RECORDING OF ALPHA PARTICLES WITH NITROCELLULOSE FILMS. Mitrofanova, A. V.; Ranyuk, Yu. N. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 4, 58-9 (July-Aug. 1968). (In Russian).

The detection properties of nitrocellulose for alpha particles are discussed. The efficiency for recording alpha particles with energy up to 5 MeV is shown to be nearly 100%. (tr-auth)

2589 SILICON AVALANCHE DIODES AS DETECTORS FOR GAMMA RADIATION. Keil, G. (Technische Hochschule, Munich). Nucl. Instrum. Methods, 65: 277-84(Nov. 15, 1968).

A semiconductor gamma detector is described which can be considered the solid-state analogue of the Geiger-Müller counter. The detector is an alloyed silicon diode operated in its breakdown region. Gamma detection occurs by diffusion of minority carriers from the ionization track of the fast electron to the avalanche channel, where a breakdown pulse is triggered (typical pulse height: 25 μA). The small counting volume in connection with a thermally produced background pulse-rate establishes a lower limit of measurable dose rates at about 20 rad/h. The usable range of dose rates can embrace 5 decades. Calculations and experimental data of the energy dependence are presented. (auth)

2590 GAMMA DOSIMETRY AT NUCLEAR REACTORS WITH DOSIMETER GLASSES. Jeltsch, E.; Graf, W. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie, 13: 425-8(Nov.-Dec. 1968). (In German).

Aspects and testing methods for usability of dosimeter glasses in nuclear reactors are being discussed. Moreover a report is given on experiments with metaphosphate glasses and on one presumably suitable glass type, which is more thoroughly described. (auth)

2591 VOLUME RESPONSE OF THE EFFICIENCY FACTOR WITH A LIQUID SCINTILLATION COUNTER. Kaczmarczyk, N. (Technische Hochschule, Munich). Nucl. Instrum. Methods, 65: 237-46(Nov. 15, 1968). (In German).

It is experimentally shown that the counting efficiency–volume-response of unquenched samples can be traced back to the optical

efficiency dependency on the filling-height. The relationship between the optical efficiency and the filling-height is explained by two effects: by the optical coupling of the sample container with the photo-sensitive cathode and by the action of the elevator-reflector. In connection with this is described, how the nature of the container material (glass, polyethylene) influences the volume response of the counting efficiency. With increasing degree of quenching the maximum counting efficiency is shifted in the direction of higher volumes of the scintillator solution. This shift is displayed as a compromise of two regularities: The increase of the chemical efficiency with rising quencher dilution and the diminution of the optical efficiency beyond the peak value with rising filling-height. In particular the volume influence on the background is investigated. The conclusions, which result from the counting efficiency–volume-response on the determination of the optimum volume, are discussed for high and for low counting rates. For highly activated samples the optimum volume, to which belongs the maximum value of the statistical goodness, is identical with that volume, that shows the highest counting efficiency. For lowly activated samples these two characteristic volumes differ the more the smaller the counting rate is. (auth)

2592 INTEGRATED CIRCUIT SOLUTION FOR AMELIORATION OF SIGNAL-TO-NOISE RATIO APPLICATION IN BORON LINED CHAMBERS OPERATING AS PULSE CHAMBERS. Mantakas, Ch.; Polychronakis, G. (Democritus Nuclear Research Center, Athens). Nucl. Instrum. Methods, 65: 314-16(Nov. 15, 1968).

A very simple chain for thermal neutron detection has been realized with 100 ohm input impedance, 15 μV (p.t.p.) noise level referred to the input and 1.5 MHz bandwidth. This is achieved by picking up two simultaneous opposite polarity signals, from the anode and the cathode of a boron lined neutron detector functioning in current collection, and by adding them in an integrated analog amplifier. The addition of the signals decreases the noise level by 2, as the amplifier thus offers double gain with practically the same noise level. (auth)

2593 PULSE RISE TIME DISCRIMINATION IN X RAY PROPORTIONAL COUNTERS. Campbell, J. L. (Univ. of Glasgow). Nucl. Instrum. Methods, 65: 333-7(Nov. 15, 1968).

The factors affecting the pulse rise time in a coaxial proportional counter are discussed, and it is shown that under certain conditions the dependence of rise time upon the length of the radial component of the primary ionization track may be considerable. A rise time discrimination system based on these arguments has been constructed; it was found possible to remove a significant fraction of the small pulses arising from gamma rays which would normally interfere with the recording of a low intensity of soft x rays from the same radioactive source. The advantages and disadvantages of the technique in coincidence experiments are discussed. (auth)

2594 HIGH RESOLUTION TIME-OF-FLIGHT MEASUREMENT WITh LARGE AREA COUNTERS. Paoluzi, L. (Univ., Rome. INFN, Rome); Visentin, R. Nucl. Instrum. Methods, 65: 345-8(Nov. 15, 1968).

In experiments on particle-antiparticle production by electron positron colliding beams, cosmic rays give a considerable contribution to total background. In particular, a large fraction of the cosmic rays which pass through the interaction region cannot be distinguished from events produced by interaction between the two beams, even when spark chamber pictures are used. A time-of-flight measurement between two counters of the experimental set up, separated by a distance d, allows us to distinguish cosmic rays from pairs of charged particles produced by an annihilation event. This time-of-flight is of the order of some ns ($\approx$4 to 8 ns, $1 \lesssim d \lesssim 2$ m) when a cosmic ray passes through the two counters, whereas it is zero for two charged particles produced in the interaction region. When large scintillation counters are used, the main difficulty in measuring and distinguishing these time intervals arises from the finite transit time of light in scintillators. By properly applying double time-of-flight methods it is possible to minimize these effects. Results of time-of-flight measurements between two $100 \times 100 \times 2$ cm^3 scintillation counters are presented. A time resolution of ± 0.7 ns has been obtained. A method to distinguish direction of cosmic rays is proposed. (auth)

2595 MONITORING OF ^{241}Pu. Denecke, B.; Spernol, A.; Vaninbroukse, R. (EURATOM, Geel, Belgium). Int. J. Appl. Radiat. Isotop., 19: 812-16(Nov. 1968).

In an endeavour to find simple and reliable methods for the monitoring of ^{241}Pu, a liquid scintillation technique employing a plastic detector coincidence counter was studied. A very simple method was applied for the correction of quenching and statistical counting losses, consisting of simultaneous single and coincidence counting and the calculation of the efficiencies of both measurements from the ratio of the measured count rates, using a suitable statistical model. It is concluded that the procedure described may be useful for the determination of ^{241}Pu activities. (UK)

2596 PERFORMANCE PARAMETERS OF SOME NEW EFFICIENT AND HIGHLY SOLUBLE SOLUTES FOR LIQUID SCINTILLATORS. Kowalski, E. (Landis and Gyr, Ltd., Zug, Switzerland); Anliker, R.; Schmid, K. Mol. Cryst., 4: 403-13 (1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Systematic investigations were made on unsubstituted and alkyl-substituted benzoxazole, benzoxazolyl-thiophene, and 1,3,4-oxadiazole derivatives as scintillator solutes. Measurements of their physical and practical properties indicated some of them to be efficient primary or secondary solutes for liquid and also for plastic scintillators. The solubilities and spectral properties of various derivatives of the benzoxazolyl-thiophene series are tabulated. Introduction of 2 or more methyl groups lowered the solubility of the basic compound instead of increasing it. On the contrary, the solubilities increased sharply by introduction of branched alkyls, such as isopropyl or sec-butyl groups. Especially, tert-butyl groups were found suitable for the solubilization. Disubstituted benzoxazolyl-thiophene, known as the scintillator BBOT, for example, was about 12 times more soluble in toluene than the unsubstituted compound. Most of the spectra of the derivatives were similar in shape. Introduction of the alkyl groups produced the expected bathochromic shifts in the spectra. It was concluded that by the introduction of branched alkyl groups, especially of the tert-butyl group, the solubilities of the benzoxazolyl-thiophene, phenylbenzoxazole, and 1,3,4-oxadiazole derivatives in toluene can be increased. (BBB)

2597 QUENCHING PROPERTIES OF ALCOHOLS IN LIQUID SCINTILLATOR SOLUTIONS. Findeis, A. F.; Lubkowitz, J. A. (Univ. of Alabama, University). Mol. Cryst., 4: 385-401(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The quenching properties of alcohols in liquid scintillator solutions were studied. Sixteen alcohols, n-C-1 to n-C-10, and branched chain alcohols up to C-5 were studied in 2 common scintillator solutions (toluene and dioxane base), using ^{14}C and tritium. Irrespective of the composition of the scintillator and independent of the activity, the quenching decreased with increasing molecular weight of the quenching agent when expressed on a volume basis. The converse was true when the composition was expressed on a molar basis. Branched chain alcohols showed a decreasing quenching ability with increasing substitution on the α-carbon. Quenching properties of binary mixtures of alcohols are intermediate between the quenching curves of the pure alcohols. The quenching behavior of the alcohols was compared with that of compounds containing the same number of carbons but different functional groups. Quenching is dependent not only upon the number of molecules but also on the steric factors affecting the functional group primarily responsible for the quenching. (BBB)

2598 SCINTILLATION MEASUREMENTS AT VERY HIGH SOLUTE CONCENTRATIONS: SELF QUENCHING-STRUCTURE CORRELATIONS. Horrocks, Donald L.; Wirth, Hermann O. (Argonne National Lab., Ill.). Mol. Cryst., 4: 375-83(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Measurements of the relative scintillation yields of some liquid organic systems were carried out with several highly soluble scintillator solutes. Self quenching was observed at high concentrations with some of the solutes, but not with others. The results were correlated with the ability of the solute molecules to come together, in a special configuration, close enough to form an association. A study of the atomic models of the solute molecules showed that those molecules with chromophor systems which were non-coplanar, or coplanar but shielded by substituent groups, did not produce self quenching. However, those solute molecules with unprotected coplanar chromophor systems did produce self quenching at high solute concentrations. (BBB)

2599 THE FLUORESCENCE AND SCINTILLATION PROPERTIES OF NEW OXAZOLES, OXADIAZOLES, AND PYRAZOLINES. Leggate, Peter; Owen, Derrek (Nuclear Enterprises Ltd., Winnipeg, Manitoba). Mol. Cryst., 4: 357-73(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The advantages of using a secondary solute in plastic and liquid scintillators, and the manner in which such solutes define scintillation performance, are reviewed. Potential secondary solutes

of general structure $Ar_1-X-Ar_2-X-Ar_1$, where X is an oxadiazole, oxazole, or 5-phenylpyrazoline group, were synthesized and their spectral and scintillation properties were measured. The relation between the molecular structure of these compounds and their spectral properties was examined. It was postulated that anomalous spectral displacements which were observed can be explained in terms of the distorting effect of the heterocyclic groups on the conjugated system. A procedure is outlined for the direct measurement of the reabsorption by a solute of its own fluorescence emission. The contribution of reabsorption to light attenuation in practical scintillators is discussed and a model experiment is proposed to determine the extent of this contribution. (BBB)

2600 LIQUID SCINTILLATORS. XIV. THE SYNTHESIS AND EVALUATION OF SOME TRANS-1,2-DIARYLETHYLENES AS LIQUID SCINTILLATORS. THE STERIC EFFECTS OF A METHYL GROUP. Daub, Guido H.; Hayes, F. Newton; Holty, David W.; Ionescu, Lavinel; Schornick, James L. (Los Alamos Scientific Lab., N. Mex.). Mol. Cryst., 4: 343-55(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

2-Arylindenes, 3-aryl-1,2-dihydronaphthalenes, 3-aryl-1, 2-dihydro-4-methylnaphthalenes, 2-aryl-6-phenylindenes, 2-aryl-3-methyl-6-phenylindenes, 2-aryl-3,4-dihydro-6-phenylnaphthalenes, 2-aryl-3,4-dihydro-1-methyl-6-phenylnaphthalenes, 2-aryl-3H-benz[e]indenes, 3-aryl-1,2-dihydrophenanthrenes, and 3-aryl-1,2-dihydro-4-methylphenanthrenes in which the substituent aryl group was phenyl (a), 1-naphthyl (b), 2-naphthyl (c), or 4-biphenylyl (d) were synthesized and tested as liquid scintillator solutes in toluene at various concentrations. Fluorescence spectra in toluene and uv absorption spectra were also determined. It was found that the compounds having the ethylenic double bond in a 5-membered ring were better scintillators at low concentrations than those having the ehtylenic double bond in a 6-membered ring; however, at increased concentration the 6-membered ring systems surpassed the 5-membered ring systems in scintillation efficiency. In addition, the presence of a methyl group on the ethylenic carbon adjacent to that holding the substituent aryl group had a profound decreasing effect on the scintillation efficiency in the 6-membered ring compounds but no decreasing effect on the 5-membered ring compounds. (BBB)

2601 CORRELATIONS BETWEEN CONSTITUTION AND SCINTILLATION PROPERTIES IN THE p-OLIGOPHENYLENE SERIES. Wirth, H. O. (Argonne National Lab., Ill.); Herrmann, F. U.; Herrmann, G.; Kern, W. Mol. Cryst., 4: 321-42(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Optimal properties of an organic scintillator solute and the structural principles involved, especially in the p-oligophenylene series are discussed. An organic scintillator solute must have a sufficient solubility in all types of solvents used for counting. Substitution by larger alkyl groups can be a very effective principle of solubilization. By use of branched, particularly long-chain branched groups, even extremely insoluble substances can be solubilized in homopolar solvents. While substitution of alkyl groups is only effective for nonpolar solvents, the use of oxa-alkyl groups (derived from ethylene oxide) affords solubility also in polar solvents. With these 2 types of substituents almost all solubility problems can be solved. High light output is of great importance. In the p-oligo-phenylene series the scintillation efficiency increases with the degree of condensation (number of rings). Thus, with higher homologs high light yields can be obtained. Substituents disturbing the coplanarity cause a decrease in light output. The fluorescence wavelengths should correspond to the response of the commonly used phototubes. By introducing certain chromophoric systems, such as pyrene or fluoranthrene, very long fluorescence wavelengths can be established. Organic scintillator solutes should have a low sensitivity to all types of quenching processes. Solubilization groups reduce self quenching. (BBB)

2602 PLASTIC SCINTILLATORS FROM CROSS-LINKED EPOXY RESINS. Markley, F. W. (Argonne National Lab., Ill.). Mol. Cryst., 4: 303-17(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Attempts have been made to produce a plastic scintillator based on epoxy resins instead of styrene or vinyl toluene, the advantages of which are many. The shrinkage on polymerization would be an order of magnitude less than styrene. Combined with low vapor pressure and a small exotherm, this would mean that scintillators could be easily cast into complex and readily reproducible shapes. Since the epoxies are cross-linked systems, such a scintillator would have greater dimensional stability, greater resistance to high temperature and to chemical or solvent attack, and essentially no tendency to stress crack or surface craze. It might be possible to operate such scintillators directly immersed in strong solvents, which could be advantageous in many chemical and biological experiments. In addition, epoxy resins systems can be easily tailored for special applications by the addition of modifying agents such as flexibilizers. (BBB)

2603 NEW LIQUID SCINTILLATORS WITH FASTER RESPONSE AND HIGHER EFFICIENCY. Lynch, Frank J. (Argonne National Lab., Ill.). Mol. Cryst., 4: 293-301(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The variation of light intensity with the time following excitation by γ rays was measured for a quaterphenyl compound whose solubility was enhanced by substitution of alkyl groups. The decay curves, measured by use of a probability-sampling technique, were analyzed to yield preliminary estimates of the time constants τ_1 related to energy transfer from solvent to solute, τ_2 related to the rapidly decaying component from the singlet state, and τ_3 related to the slower component which is probably due to excimers. A solution ($\sim$65 g/l, $\gamma = 1.12 \times 10^{-2}$) of $1^1,4^4$-bis(2-butyloctyloxy)-p-quaterphenyl (QP-G12) in toluene shows $\tau_1 \cong 0.05$ nsec, $\tau_2 \cong 1.4$ nsec, and $\tau_3 \cong 11.4$ nsec. The intensity of the slow component (mean life τ_3) is about 20% of that of the fast component (mean life τ_2). This is about a third of the slow-fast ratio measured for 2,5-diphenyloxazone (PPO) in toluene at the same mole fraction. This indicates that QP-G12 does not form excimers as readily as PPO does. For both solutes, measurement shows that τ_1 varies about as the reciprocal of the concentration, as expected. For the same mole fractions, moreover, the fact that the value of τ_1 for QP-G12 is only about half that for PPO indicates that the rate of transfer from solvent molecule to solute is higher for QP-G12 than for PPO. The QP-G12 has a higher light output and shorter τ_1 and τ_2 than the plastic Naton 136 which is commonly used for delayed-coincidence measurements. Preliminary attempts to exploit this advantage led to improved time resolution; for 511-keV γ rays, the full width at half maximum was about 0.25 nsec and the slope of the decay curve was $T_{\frac{1}{2}} \cong 0.037$ nsec. (BBB)

2604 SENSITIVITY ENHANCEMENT FOR LOW LEVEL ACTIVITIES BY COMPLETE SYNTHESES OF LIQUID SCINTILLATION SOLVENTS. Tamers, M. A. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Mol. Cryst., 4: 261-76 (1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Optimally, for liquid scintillation measurements of low level radioactivity, most of the solvent should be composed of the same material as the sample counted. This concept was applied to 3 natural-radioactivity dating methods. For ^{14}C, the most sensitive and practical of the various liquids investigated was benzene, which, in addition to being a good liquid scintillation solvent, contains 92% carbon. Synthesis of benzene for ^{14}C dating is described. Yields now approach 100% and less than 8 hr total chemical preparations time is required. The C isotope effect is small and is reproducible to 70.5%. Synthesis of benzene for low level tritium measurements was also investigated. Benzene contains 8% hydrogen, but the chemical technique is considerably simpler than that used for radiocarbon dating. Due to the faster preparation, large quantities of benzene for tritium dating can be produced and the sensitivity increased. An isotope effect of -34% was observed, but is sufficiently reproducible so as not to pose a problem in the use of liquid scintillation counters for tritium dating. The possibility of age determinations with naturally occurring ^{36}Cl is attractive due to the long half-life of the isotope. Dating of samples with ages of more than a million years is possible. A procedure now being developed consists of the synthesis of an inorganic liquid, silicon tetrachloride, from the chlorine of the sample to be dated. The chemical preparation is rapid and has an average yield of 75%, but the compound is not suitable for use without the presence of an organic solvent in which the scintillator must be dissolved. Nevertheless, with silicon tetrachloride much larger quantities than previously possible can be counted and the method offers promise of eventually making ^{36}Cl dating practical. (BBB)

2605 LIQUID SCINTILLATORS AT HIGH TEMPERATURES. Furst, M.; Kallmann, H.; Levin, E. (New York Univ., N. Y.). Mol. Cryst., 4: 213-30(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Investigation of the effect of raised temperatures on the luminescence properties of organic liquid scintillators is reported, especially the effect of temperatures up to 250°K above room temperature on energy transfer from the bulk material (solvent) to the emitting substance (solute) under γ-ray and uv excitation. Solvent when excited with no solute present exhibited a very dif-

ferent behavior. Results are shown for a number of solvent substances which give good fluorescence. Under both γ-ray and uv excitations there was a monotonic decrease in emission with increasing temperature, except for anisole which was anomalous because of its excimer formation. For a given solvent, the decrease of intensity with temperature was slightly more gradual under uv excitation, indicating that the contribution from higher excited states (or ionization) is temperature dependent. The fluorescence of 2,5-diphenyloxazole in p-xylene under 3130 Å is described. Under excitation by high energy radiation or light usually a reduction in fluorescence with high temperatures was found. However, when excimers were present, a rise could be found. The energy transfer as a function of temperature was studied by a theoretical formula, and was found to be greatly temperature dependent. Its dependence was found to be directly associated with variation in fluorescence properties of the solvent by itself. (BBB)

2606 THE FLUORESCENCE DECAY TIMES OF THE TWO DAVYDOV COMPONENTS IN NAPHTHALENE CRYSTALS. El Kareh, T. B.; Wolf, H. C. (Technische Hochschule, Stuttgart). Mol. Cryst., 4: 195-200(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The 2 fluorescence decay times τ_a and τ_b for naphthalene crystals were measured. In naphthalene, the origins for exciton luminescence are situated at 31475 (a component) and 31625 cm^{-1} (b component) above the ground state. The Davydov splitting is 150 cm^{-1}. The oscillator strength for the higher Davydov component is ~4 times greater than that of the lower component. Fluorescence decay was determined as a function of temperature between 300 and 4°K and of thickness between 1 μ and 3 mm. The crystals were excited by light pulses of short duration ($T_{\frac{1}{2}}$ = 9 nsec) in the wavelength region between 3400 and 2900 Å. At 4°K the total fluorescence intensity originates at the lower Davydov component, τ_a = 115 nsec ± 5 nsec. At room temperature reabsorption was very strong. By plotting the τ values as a function of thickness d at room temperature and extrapolating to d = 0 a value of $\tau \cong$ 40 nsec was obtained. This decay time could be considered as composed of 2 components τ_a and τ_b with vanishing reabsorption. The upper Davydox component τ_b was calculated to be 33 ± 5 nsec. (BBB)

2607 QUENCHING MEASUREMENTS ON ORGANIC SCINTILLATORS. Yates, E. A.; Crandall, D. G.; Kirkbride, J. (EG and G, Inc., Santa Barbara, Calif.). Mol. Cryst., 4: 165-70(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

As part of a program to develop faster liquid organic scintillators having shorter decay times and a minimum of long-tail light output, an experimental method was used in which the time distribution of the decay of the scintillation light emission was measured in the nanosecond range. Oxygen and several other quenchers were examined. The base liquids employed were NE211, NE213, NE226, trimethylbenzene, and toluene. (The NE series of liquids was manufactured by Nuclear Enterprises, Ltd.). The effect on NE226 (C_6F_6 base) of bubbling first with N_2, then with O_2, and then with N_2 again is shown. After the second N_2 bubbling, the scintillator was restored to the condition it had after the first N_2 bubbling. Decay measurements showed that O_2 quenching considerably reduces the ratio of tail-to-peak responses. In similar experiments performed on NE211, NE213, toluene with 3 g/l of PPO, and trimethylbenzene with 2 g/l p-terphenyl, in all cases the quenching results closely followed those obtained on NE226. When oxygen-bubbled samples were sealed off, immediately measured, and then remeasured after several weeks, in most cases, the effects of oxygen quenching had partially disappeared. Pulse-height, decay-time, and tail amplitudes all varied in a linear fashion with acetophenone concentration, when it was used for solvent quenching. In measurements made with other quenching liquids, pulse heights were reduced in all cases; decay times and tail-to-peak ratios, however, increased in some cases but not others. Oxygen was the best quencher of tail emission and piperidine the best reducer of decay time. Thus, oxygen, in its effects of reducing decay time and tail light output, is the most powerful single quencher examined, but sealed-off samples slowly lose the effect of dissovled oxygen over several months. Next to oxygen, bromobenzene is the best all-around quencher for reducing the scintillation tail. It also reduces the decay time. Acetophenone reduces the decay time but leaves the tail unchanged. (BBB)

2608 FACTORS RELEVANT TO A SHORT LIFETIME OF AN AROMATIC MOLECULE: EMPIRICAL DATA. Berlman, I. B. (Argonne National Lab., Ill.). Mol. Cryst., 4: 157-63 (1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Some aromatic molecules, such as p-terphenyl, have relatively fast fluorescence rise and decay times. However, with recent developments in fast electronic circuitry and in photomultiplier tubes, scintillators are needed with even faster decay times. Some factors relevant to a short life-time are discussed, mainly from an empirical viewpoint. In certain linear systems the fluorescence lifetime decreases as the molecular length increases; the molar extinction coefficient ϵ increases with molecular size. How the natural fluorescence lifetime τ_0 of an aromatic molecule can be computed from ϵ and certain other parameters of its absorption spectrum is discussed. From classical theory the 1-dimensional oscillator strength f of a transition can be calculated from the equation $f = 4.32 \times 10^{-9}\, n \int \epsilon d\nu$, where n is the refractive index of the liquid and ν is a wave number in cm^{-1}. Comparison is made of the f value of one of the fastest scintillators, $1^2,2^3,5^2,6^3$-tetramethylsexiphenyl, with the classical limit of 1. This molecule has an ϵ_{max} of 64,000 l/mole-cm and a τ_0 of 0.81 nsec. The value for the sexiphenyl molecule is calculated to be 2.56, close to a limiting value of f. It is not known whether a slightly longer p-oligophenylene such as p-octaphenyl, if solubility problems can be overcome, would have even larger values of ϵ_{max} and f and therefore a τ_0 less than 0.8 nsec. As the p-oligophenylenes get longer they will eventually reach a size where they are no longer linear and a further increase in size should not result in an increase in ϵ_{max}. Whether such a possibility is related to the absorption and fluorescence limits of longer p-oligophenylenes and by the classical limitation of $f \simeq 1$, is not known. The p-oligophenylenes appear to possess all of the characteristics favorable for short decay times. In particular, $1^2,2^3,5^2,6^3$-tetramethylsexiphenyl is probably the fastest scintillator in use today. The molecule is linear with uninterrupted conjugation throughout its length. Not only does it have a high ϵ_{max} but the center of gravity of the fluorescence-spectrum occurs at 3800 Å, so that ν_0 is also large. In addition to other attributes this molecule has a high quantum yield. If, in a particular experiment, fluorescence intensity can be sacrificed, then through internal or external quenching reduce the quantum yield Q can be reduced and thus, as seen by the equation $\tau = \tau_0 Q$, reduce the fluorescence decay time τ. (BBB)

2609 FLUORESCENCE DECAY OF LIQUID SCINTILLATOR SYSTEMS AFTER HIGH-ENERGY EXCITATION. Ludwig, Peter K. (Univ. of Notre Dame, Ind.). Mol. Cryst., 4: 147-56(1968). (COO-38-505).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Many liquid scintillator systems exhibit a nonexponential fluorescence decay after uv or high-energy excitation, the observed deviations from exponentiality for uv excitation being explained by the formation of excited dimers; i.e., excimers. Liquid scintillator fluorescence after excitation by high-energy irradiation indicates that the dynamic fluorescence behavior does not essentially differ from that of fluorescence excited by uv, particularly where the scintillator has a long decay time ($>10^{-8}$ sec) and has a strong tendency to form excimers. However, the fluorescence decay curves for fast liquid scintillators, which have no, or little, tendency for excimer formation, also show nonexponential decay characteristics when excited by high-energy radiation, although the same system after uv excitation displays exponential decay. The nonexponentiality, therefore, does not seem related to dimer formation. The fluorescence decay curves for 30-kV x-ray- and uv-excited 2,5-diphenyloxazole (PPO) and p-terphenyl in cyclohexane are shown. The observed slow component of luminescence after high-energy excitation of cyclohexane systems is considered. In systems made up from aromatic solvents this tail can be attributed to triplet-triplet annihilation of the solvent molecules, but the phenomenon in cyclohexane systems cannot be explained on the same basis. The role of ionic processes is discussed. When the reactants are sufficiently separated, the formation of excited scintillator molecules, rather than the emission process, will be rate determining. It was shown that a negative-ion former is particularly informative when used as a quencher for it clearly distinguishes between effects that can be attributed to ions and those which are ascribable to excited species. Luminescence decay curves in cyclohexane scintillator systems excited by high-energy radiation are interpretable in terms of ionic reactions, not a mechanism involving excited solvent molecules. The behavior in scintillator systems with aromatic solvents may well follow the same scheme. However, here the existence of long-lived excited solvent molecules may make the energy-transfer process rate controlling and obscure the ionic reactions. (BBB)

2610 LUMINESCENCE DECAY OF ORGANIC SCINTILLATORS. Laustriat, G. (Centre de Recherches Nucleaires, Strasbourg). Mol. Cryst., 4: 127-45(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Data on the luminescence decay of organic scintillators are reviewed. Theoretical equations, resulting from an analysis of the scintillation process, are shown to be in good agreement with experimental decay curves obtained with crystals and liquid scintillators. The pulse shape discrimination of particles is discussed, and a technique allowing separation of α particles, protons, and β rays is presented. The usual n-γ discrimination devices do not allow separation of α particles from recoil protons. The results presented indicated that α emission is important and may cause serious errors if not taken into consideration. The energy distribution of the incoming particle can be determined by using either fast or slow pulses only. The energy resolution is about the same in the 2 cases. However, the use of the slow pulses for neutron energy measurements is of particular interest since a linear relation is observed between the amount of light emitted in the slow component and the energy of the particle, while this is not the case for the fast component. Besides its interest for pulse shape discrimination techniques, the knowledge of radioluminescence decay curves aids in verification of decay laws derived from theoretical considerations, and it enables information to be obtained on the nature of the basic processes induced by nuclear particles in organic media. For instance, the agreement found in the present analysis between decay curves and kinetic equations gives experimental evidence that bimolecular interactions between some activated species (probably molecules excited in their lowest triplet level) leading to delayed singlet states occur efficiently in high activation density regions (track and spurs). (BBB)

2611 VALIDITY OF PERRIN'S EQUATION IN SOLUTE QUENCHING. Peng, C. T. (Univ. of California, San Francisco). Mol. Cryst., 4: 109-24(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

A redefinition was made of the relation between the fluorescence power, Q, of a dye and its concentration, c, introducted by Perrin in the form of the equation $Q = Q_0 \exp(-c/c_m)$, where Q_0 is the value which Q tends to as the concentration c tends to zero and c_m is the concentration at which maximum fluorescence of the dye solution occurs. In sensitized fluorescence systems employed in liquid scintillation counting, quenching of fluorescence depends upon an exponential function of the concentration of the quencher and an empirical equation can be derived which is identical in form to the above equation. Thus, by inference, the exponential factor in Perrin's equation for concentration quenching should be generally valid. Evidence on the validity of the equation in solute quenching is presented, showing that if Q is redefined as apparent specific fluorescence intensity, namely the observed intensity per unit concentration of solution and Q_0 as the specific fluorescence intensity in the absence of concentration quenching. The organic scintillators 2,5-diphenyloxazole, 2-(1-naphthyl)-5-phenyloxazole, 1,4-bis-2-(4-methyl-5-phenyloxazolyl)benzene, p-terphenyl, naphthalene, and anthracene were excited in solutions by β radiation from ^{14}C and from tritium, achieved with ^{14}C- and ^{3}H-labeled toluene, and by γ radiation with the external standard ^{226}Ra. Multicomponent concentration quenching curves were obtained by plotting log(I/c) vs c. Addition of quencher to the solvent-solute system and use of inefficient solvent caused the quenching curves to become linear. Based on the shift of maximum activating wavelength during photoactivation, formation of excimers or molecular aggregates of similar nature is postulated to explain the observed phenomenon. (BBB)

2612 ENERGY TRANSFER AND QUENCHING IN PLASTIC SCINTILLATORS. Hirayama, F. (Argonne National Lab., Ill.); Basile, L. J.; Kikuchi, C. Mol. Cryst., 4: 83-108(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The plastic systems studied were polystyrene + fluor + quencher, and polystyrene + quencher, with 9,10-diphenylanthracene as the fluor. The quenchers were p-dichlorobenzene, p-dibromobenzene, hexachlorobenzene, 1,2,3,4,5,6-hexachlorocyclohexane, 2-chloronaphthalene, and 2-bromonaphthalene. The data obtained were analyzed by typical quenching kinetics, and the solvent quenching constant and the solute quenching constant determined for each series studied. Results showed that solvent quenching observed under uv excitation is due mainly to the competition between dipole-dipole energy transfer from polystyrene to the fluor and that from polystyrene to the quencher, and that such a transfer occurs directly from an excited polystyrene segment before it forms an excimer with an unexcited segment. Solvent quenching under β-ray excitation was generally greater than that under uv excitation. This phenomenon may result from the occurrence of energy transfer at higher excited state of polystyrene. Solute quenching in some series of polystyrene + 9,10-diphenylanthracene + quencher was not accounted for by usual mechanisms of quenching. Such quenching could be explained by assuming energy transfer from the singlet excited state of 9,10-diphenylanthracene to the triplet state of the quencher. In an appendix, efficiencies of excimer formation in polystyrene were calculated. The efficiencies were 0.99, 0.98, and 0.97 in cyclohexane, p-dioxane and 1,2-dichloroethane, respectively. (BBB)

2613 MEASUREMENT OF TRANSFER EFFICIENCIES AND RADIATIVE TRANSFER OF AROMATIC SOLVENTS AT VERY-LOW SOLUTE CONCENTRATIONS. Horrocks, Donald L. (Argonne National Lab., Ill.). Mol. Cryst., 4: 45-59(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

Measurements of luminescence yields as a function of the solute concentrations in aromatic solvents were made at low solute concentrations, down to 0.005 g/l. Only at these low concentrations was it possible to get information on other processes which might occur in the liquid scintillator solution system, particularly the contribution to the luminescence yield of a possible radiative transfer process at low solute concentrations. A semi-empirical formula was developed to explain the measured light yields, and a computer program was used to evaluate the parameters of this equation. The luminescence yields were measured for liquid scintillator solutions excited by both α particles and electrons. The solvent used was toluene, and 2 solutes were 2,5-diphenyloxazole, PPO, and 1,4-bis-2-(4-methyl-5-phenyloxazolyl)benzene, M_2-POPOP. The radioactive sources were ^{113}Sn for electron excitation and ^{238}Pu for α particle excitation. Results showed that a radiative energy transfer process becomes quite important at very low solute concentrations; e.g., at 0.01 g/l as much as 60% of the observed light is a result of the radiative energy transfer process. Some parameters obtained from the semi-empirical equation relating the measured luminescence yield and solute concentration gave information on other processes which occur in liquid scintillators. Thus, dynamic quenching increased with increasing specific ionization of the exciting particle and with decreasing temperature. The fraction of the excited solvent molecules which produce radiative transfer increased with increasing specific ionization of the exciting particle and with increasing temperature. The fraction of radiative transfer which actually transfers to solute was mostly independent of mode of excitation (for α or e^-) and only slightly dependent on temperature. Transfer efficiencies were greater for excitation particles of lower specific ionization and for higher temperatures. The overlap of spectra of solvent emission and of solute absorption was an indication of the relative amounts of overlap for different solutes. The α/β ratio was a complex function of temperature and solute concentration. A method is described which can be used to obtain information about the energy transfer processes with any solvent-solute system. Thus, for different solutes, information can be obtained to correlate between solute constitution and the above listed properties of the scintillator solution. (BBB)

2614 SCINTILLATION EFFICIENCY OF BENZENE. Skarstad, Paul; Ma, Renee; Lipsky, Sanford (Univ. of Minnesota, Minneapolis). Mol. Cryst., 4: 3-14(1968). (COO-913-8).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The scintillation efficiency of a crystal, defined as either the proton energy or number of photons emitted per eV of absorbed exciting radiation, can be used together with independently measured emission quantum yields to determine directly the G value for production of the emitting state of the crystal. For thick crystals of anthracene (d > 1.5 mm) excited by fast electrons, a scintillation efficiency of ca 0.040 or equivalently 0.015 photons emitted per eV absorbed, is generally accepted. Using a value of 0.68 for the technical fluorescence quantum yield, a G value of 2.2 is obtained for production of the emitting state of anthracene. Diphenylacetylene, stilbene, naphthalene, terphenyl, and dibenzyl have the substantially lower G values of 1.1, 1.5, 1.2, 1.2, and 0.9. The G value for production of $^1B_{2u}$ benzene using ^{14}C as excitation source was determined and compared with these and other G values. The technique employed involved a comparison of the ^{14}C-excited emission from a benzene + p-terphenyl solution with the emission produced by optical excitation of the same solution in the p-terphenyl absorption band. After correction for differences in emission geometries, and the additional measurements of absorbed photon intensity and p-terphenyl fluorescence quantum yield, it was possible to determine directly the total emitted quantum flux for ^{14}C-excitation. The scintillation efficiency of benzene + p-terphenyl solution, extrapolated to unit energy transfer efficiency, was found to be 0.042 (or equivalently 0.0116 ± 0.004 photon/ev), corresponding to a G value for production of $^1B_{2u}$ benzene of 1.55 ± 0.05. The difference between this value and that for other alkyl benzene liquids (1.9 to 2.5) and for anthracene crystal (2.20) may be related to the efficiency with which upper states of these substances

make internal conversion to the emitting or transferring state. (BBB)

2615 VACUUM ULTRAVIOLET EXCITED LUMINESCENCE OF PURE AND DOPED POLYSTYRENE. Weinreb, A.; Leibowitz, M. (Hebrew Univ., Jerusalem). Mol. Cryst., 4: 15-31(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The overall fluorescence yield and fluorescence spectrum of polystyrene as well as the fluorescence yield of solid solutions of anthracene and of diphenyloxazole in polystyrene are studied as a function of excitation wavelength in the region 584–3000 Å. In all cases a strong dependence of the investigated properties on excitation wavelength is found. The fluorescence yield and spectrum of polystyrene in solution is basically different from that of the solid phase. For the fluorescence yield of the solid two basic types of behavior are found, depending on the preparation and treatment of the sample. The remarkable dependence of the fluorescent spectrum of solid polystyrene on excitation wavelength is also strongly depending on the mode of preparation. In all cases there is a pronounced correlation between the absorption spectrum of polystyrene and its fluorescent properties, a greater intensity and stronger red shift corresponding to a higher absorption coefficient. The variation in fluorescence yield of plastic solutions of anthracene and diphenyloxazole in polystyrene with excitation wavelength is very different from that for pure polystyrene. In fact for highest acceptor concentrations the former is practically opposite to the latter, indicating a strong competition between exciton transfer within the solvent and transfer to the solute. The results indicate the decisive influence of the state of aggregation as well as of the structure of the solid on the luminescent behavior for excitation of higher electronic levels. (auth)

2616 SOLVENT–SOLVENT ENERGY MIGRATION IN LIQUID SCINTILLATORS. PART II. van Loben Sels, J. W.; Dubois, J. T. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Mol. Cryst., 4: 33-44(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The quenching of benzene monomer fluorescence by biacetyl at 28°C is studied as a function of dilution with hexane and cyclohexane. The component of the overall transfer rate constant, attributable to solvent-solvent energy migration is shown to vary linearly with benzene concentration and is independent of the diluent. The results are discussed in the light of the work of others. (auth)

2617 FLUORESCENCE QUENCHING AND EXTERNAL SPIN-ORBIT COUPLING EFFECTS. Kearvell, A.; Wilkinson, F. (Univ. of East Anglia, Norwich, Eng.). Mol. Cryst., 4: 69-81(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The quenching of the fluorescence of antharacene and some of its mesoderivatives by heavy atom quenchers in various solvents has been shown to be dependent on the solvent, the quencher, and especially on the nature of the substituent. Anthracene shows good agreement with the Stern–Volmer equation in all solvents even in the presence of very high concentrations of quencher. However, marked derivations from this equation are observed for certain anthracene derivatives and in some cases the heavy atom quencher leads to an increase rather than to a decrease in the fluorescence. Possible reasons for this behavior are discussed and bimolecular rate constants for quenching are given where appropriate. (auth)

2618 ORGANIC SCINTILLATORS. Proceedings of the International Symposium, Argonne National Laboratory, June 20–22, 1966. Horrocks, Donald L. (ed.). Molecular Crystals. Volume 4, 1968. New York, Gordon and Breach, Science Publishers, 1968. 419p. (CONF-660612).

Separate abstracts were prepared for each of the thirty papers presented. (B.G.D.)

For abstracts of individual papers see: 2287–2293, 2596–2617, and 2675.

2619 SMALL PULSED FISSION CHAMBER. Dmitriev, A. B.; Malyshev, E. K.; Reformatskaya, I. A. Prib. Tekh. Eksp., No. 4, 55-8(July-Aug. 1968). (In Russian).

The parameters of a small-dimensional pulsed fission chamber with a combination of various fissionable materials are described. The use of U, Pu, Np, and Th in alcohol solutions in the chamber is described in detail. (tr-auth)

2620 OPTIMUM ADJUSTMENT OF THE SCINTILLATION COUNTING EQUIPMENT FOR RADIOISOTOPE DIAGNOSTIC STUDIES WITH EXTREMELY LOW ACTIVITIES. Husak, V.; Charamza, O.; Wiedermann, M. (Palacky Univ., Olomouc, Czech.). Acta Univ., Palacki. Olomuc., Fac. Med., 42: 189-98 (1966).

Two methods for adjusting scintillation detectors for optimum counting conditions are discussed. The first method is to chose a convenient amplifier gain and a fairly strong source of the radioisotope of interest to obtain the dependence of R_g, R_B, and R_N^2/R_B, where R_g is the gross counting rate, R_B is the background, and R_N is the net counting rate, on the bias voltage for various values of the high voltage. The second method is when a sample is counted at the series of high voltages for a fixed amplifier gain and various bias voltages. (B.G.D.)

2621 CALIBRATION OF THE 1383A IONISATION CHAMBER FOR ^{132}I. Goodier, I. W.; Hughes, F. H. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop., 19: 889-90(Dec. 1968).

The activity of an iodine-132 solution was measured by the $4\pi\beta$-γ coincidence technique and the standardized solution used to determine a calibration factor for ^{132}I in the 1383A ionization chamber. (auth) (UK)

2622 LABORATORY MEASURING INSTRUMENTS. Aliaga-Kelly, D. (Nuclear Enterprises, Edinburgh). Meas. Instrum. Rev., 15: 799-801(Nov. 1968).

Changes in the design of nuclear instruments over the past ten years are reviewed, with emphasis on alpha, beta, gamma, neutron, and heavy particle detector systems. (UK)

2623 A PORTABLE REM RESPONDING DETECTOR FOR THE ENERGY RANGE 4 TO 30 MeV. Gifford, B. R. (Univ. of Rochester, N. Y.). Health Phys., 15: 549-50(Dec. 1968).

It is stated that the FN-1A fast neutron survey instrument, consisting of an NE-404 fast neutron scintillator mounted on to a photomultiplier tube, can be converted to a rem responding neutron detector for the energy range 4 to 30 MeV when properly calibrated. If the FN-1A is calibrated with a source of 14 MeV neutrons so that the instrument reads 1.45 n/cm^2/sec per unit neutron flux incident upon the face of the scintillator, it will be normalized with respect to 4 MeV neutrons. (auth) (UK)

2624 AN INVESTIGATION OF THE DEGRADED NEUTRON FLUX IN A 14-MeV NEUTRON-ACTIVATION CELL. Francois, P. E. (Univ. of Aston, Birmingham, Eng.). Analyst, 93: 720-1 (Nov. 1968).

Measurements were made of the fluxes of thermal and indium resonance neutrons near the target of a 14-MeV neutron generator in a small irradiation cell. These measurements can be used to assess the importance of interfering reactions in fast-neutron activation analysis. For a fast-neutron output of 10^9 neutrons per second the measured sub-cadmium flux was 3.8×10^4 neutrons per cm^2 per second, and the flux at the 1.4-eV indium resonance was 1.3×10^3 neutrons per cm^2 per second per eV. (auth)

2625 UNIVERSAL SCINTISCANNER NEWLY DEVELOPED. Kashiwazaki, Masaaki; Kurihara, Shigeyasu (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rebyu, 23: 1313-19(Oct. 1968). (In Japanese).

A new scanner has been developed to be used for conventional area scanning, isosensitive scanning, laminoscanning, positron scanning and double-tracer scanning. This scanner consists of the following parts: two 5-in. (diameter) × 2-in. (thickness) NaI (Tl) detectors and their collimators, two supporters, a scanning device, two spectrometers and two scalers, two recorders, and an operation selector. Each detector is held by a supporter, and its weight is balanced with a counterweight in the supporting post; detectors are connected with the scanning device by a connecting rod which is moved rectilinearly; two detectors can be set each on one side of a patient opposite to each other. Detected signals are fed from the detector to the operation selector, in which pulses are divided or mixed, and then fed into the spectrometers and scalers. After being amplified and analyzed in the spectrometer, the signals are fed into the recorders that comprise a photo- and a dot-recorder on a dual channel. With this new scanner, various types of scanning as mentioned above can be performed with ease and high accuracy. (auth)

2626 IMPROVEMENTS IN OR RELATING TO IONIZATION CHAMBERS. Betchen, Georges; Cadelec, Jacques; Coutrot, Vincent; Joffre, Henri; Langiaux, Louis (to Commissariat a l'Energie Atomique). British Patent 1,134,512. Nov. 27, 1968. Priority date Mar. 11, 1965, France.

An ionization chamber having a wall material and gaseous atmosphere whose composition is such that the interactions with beta radiations, neutrons, x rays, and gamma rays are substantially the same as with human beings is described. (W.H.K.)

2627 MEASUREMENT OF DEAD-TIMES BY THE COINCIDENCE METHOD. Granados, C. E.; Vigon, M. A.; Verdaguer,

F. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 155-60(May-June 1967). (In Spanish).

The correction formula for a very particular case of coincidence counting with different non-extending dead times in the two detector channels is derived. This formula provides a simple and accurate general method for measuring non-extending dead times. (auth)

2628 NUCLEAR TRACK REGISTRATION IN SOLIDS BY ETCHING. Becker, K. (Oak Ridge National Lab., Tenn.). Biophysik, 5: 207-22(1968).

A review is given on recent developments in the field of charged particle track registration in insulating solids by preferential etching. The basic mechanism of latent track formation in minerals and inorganic glasses seems to be a spike formation process. In the more sensitive organic polymers, radiation induced chemical changes along the track probably predominate. The sensitivity, etching kinetics, and stability of tracks in plastics and some of the factors which affect them are discussed on the basis of experimental data. Several microscopic and macroscopic methods for simplified or automatic track counting are described briefly. Among the many applications of the etching method, neutron dosimetry via (n,f), (n,α), and recoil reactions are discussed in some detail. Other applications in nuclear physics, chemistry, biology, space research, and for age determinations in geological and archeological samples are listed. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 3532 and 3940.

2629 (AERE-M-2009) THE DERIVATION OF A TRITON ENERGY RESPONSE FUNCTION FOR ^{6}Li SEMICONDUCTOR SANDWICH SPECTROMETERS. Silk, M. G. (Atomic Energy Research Establishment, Harwell (England)). June 1968. 19p. Dep. CFSTI. UK 3s. 6d.

A calculation of the triton energy response function is described in which the geometry of lithium-6 semiconductor sandwich spectrometers of the surface-target type is taken fully into account. The calculations assume an isotropic fast neutron flux, but this is not considered a serious limitation for reactor studies. The effects of the uncertainty in the present values for the differential cross-section of the ^{6}Li(n,t)^{4}He reaction are also considered, and it is concluded that the full potential of this technique for determining fast neutron spectra cannot be realized until these discrepancies are resolved. At present systematic errors of up to 20% may occur in the lower-energy ranges. (auth)

2630 (IAE-1457) SCINTILLATION SUM-COINCIDENCE GAMMA SPECTROMETER. Danelyan, L. S.; Efimov, B. V.; Sotnikov, S. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1967. 24p. (In Russian). Dep.

A scintillation gamma spectrometer made of two sodium iodide crystals designed on the sum-coincidence principle is described. A detailed description is given of the electronic circuit and of the method of measuring low-intensity partial gamma transitions at individual neutron resonances. (auth)

2631 (JUL-522-RG) USE OF THE ^{3}He SANDWICH SEMICONDUCTOR NEUTRON SPECTROMETER FOR MEASUREMENT OF SPECTRA OF DIFFERENT NEUTRON SOURCES COMMON IN REACTOR TECHNOLOGY. Cloth, P.; Hecker, R. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Apr. 1968. 47p. (In German). Dep.

The efficiency of ^{3}He-sandwiched semiconductor spectrometers for measuring spectra of neutron sources is examined. The spectrum of an Am–Be source was measured at energies over 5 to 6 MeV. Spectra up to 11 MeV were also measured with good resolution. It is shown that the problems encountered in measuring fast neutrons with the semiconductor material in the ^{3}He-sandwiched spectrometer are not as difficult as with a ^{6}Li semiconductor spectrometer. It was shown that the spectral measurements with the ^{3}He-sandwiched semiconductor spectrometer on neutrons which lie under the threshold energy of these silicon interferring reactions lead to excellent results. As an example, the measurement of the spectrum of DD neutrons is possible. Difficulties occur at high γ fluxes, which can not be resolved by the spectrometer in the upper range. Therefore the spectrum of the Am–Be source can be measured only up to 2.5 MeV and the spectrum of the ^{252}Cf fission neutrons up to 2 MeV. The effect of the energy thresholds and the geometric resolution by simple models were considered. (tr-auth)

2632 (KURRI-TR-38) ROTATING TYPE OF NEUTRON BEAM MODULATING DEVICE. Ishikawa, Yoshiaki; Fukada, Minoru; (and others) (Kyoto Univ. (Japan). Research Reactor Inst.). July 26, 1967. 51p. (In Japanese). Dep.

A neutron beam modulating device which modulates a neutron beam from a reactor thermal column sinusoidally by a rotating disc is described. This device can be used in neutron wave propagation experiments of thermal neutron systems and examples are given. (NSA of Japan)

2633 ELECTRON–GAMMA ANGULAR CORRELATION APPARATUS USING A Si(Li) DETECTOR. Kawakami, Hirokane; Manabe, Katsushi; Hisatake, Kazuo (Tokyo Inst. of Tech.). Jap. J. Appl. Phys., 7: 1397-1400(Nov. 1968).

An electron-gamma angular correlation apparatus was constructed with a Si(Li) detector for electrons and a NaI(Tl) detector for gamma rays. Its design and operation are described. The performance was tested with the 1.064 and 0.570 MeV cascade in ^{207}Pb following the decay of ^{207}Bi. The agreement between the test experiment and theory is satisfactory. (auth)

2634 Ge(Li) GAMMA-RAY SPECTROMETRY AS A PILOT FOR NaI(Tl) GAMMA-RAY SPECTROMETRY. Guinn, V. P.; Graber, F. M.; Fleishman, D. M. (Gulf General Atomic Inc., San Diego, Calif.). Talanta, 15: 1159-63(Nov. 1968).

Lithium-drifted germanium semiconductor detectors give much better resolution than do thallium-activated sodium iodide detectors, but much lower sensitivity. They can often advantageously be used in conjunction with NaI(Tl) detectors to show whether corrections must be applied for activities other than that measured and to provide the necessary information for calculation of corrections. (auth)

2635 MEASURED NE-213 FAST-NEUTRON SPECTROMETER (WITH GAMMA-RAY DISCRIMINATOR) RESPONSE FUNCTIONS AND ABSOLUTE EFFICIENCY. Simons, G. G. (Kansas State Univ., Manhattan); Smith, R. K.; Hansen, G. E.; Meyer, W. Trans. Amer. Nucl. Soc., 11: 704-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2636 THE OBSERVATION, BY THE METHOD OF SUM AND COINCIDENCES, OF γ TRANSITIONS CONSTITUTING MULTIPLE CASCADES. Forest, Hugues; Ythier, Christian (Faculte des Sciences, Nice). Compt. Rend., Ser. A and B, 267: 525-8(Sept. 2, 1968). (In French).

A spectrometer for the study of the γ radiation by the Hoogenboom method was developed by associating a semiconductor detector and a well-type scintillator. This device permits the observation not only of double cascades, but even of the multiple cascades. This is shown on the example of ^{75}As. (tr-auth)

2637 NEW GRAPHICAL METHOD FOR THE ANALYSIS OF GAMMA SPECTRA. Steffens, F.; Phan-ngoc, T.; Henrion, J. (Univ. Officielle du Congo, Lubumbashi). Nucl. Instrum. Methods, 65: 327-32(Nov. 15, 1968). (In French).

A graphical method for the analysis of γ-ray spectra obtained by a multichannel analyser is presented. After a brief revision of the properties of the Gaussian function, the new method is exposed and illustrated by some applications. The results obtained, corroborate the validity of the process. (auth)

2638 SPECTRUM STABILIZER FOR PROPORTIONAL AND SCINTILLATION DETECTORS. Sastry, N. P.; Nagarajan, R.; Memon, K. J. (Tata Inst. of Fundamental Research, Bombay). Nucl. Instrum. Methods, 65: 341-4(Nov. 15, 1968).

Random modulation of the window of a single channel analyzer used for stabilizing a spectrum simplifies the control circuitry. A stabilizer based on this principle is described. (auth)

2639 SPECTROMETER WITH Ge(Li) DETECTOR IN ANTICOINCIDENCE. Sadokhin, I. P.; Lashchuk, A. I. Prib. Tekh. Eksp., No. 4, 39-40(July-Aug. 1968). (In Russian).

An anticoincidence spectrometer using a Ge(Li) detector with a volume of 1.6 cm^{3} is described. The resolution of the spectrometer for a cobalt-57 gamma-ray (122 keV) is 4.5 keV. A decrease of 50 to 70% was obtained for the Compton distribution. (tr-auth)

2640 IMAGE PROPERTIES OF AN ELECTROSTATIC CYLINDRICAL ELECTRON SPECTROMETER. Karras, Matti; Pessa, Markus; Aksela, Seppo (Univ. of Oulu, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, 289: No. 289, 1-11(1968).

The focusing of nonrelativistic electrons in an electrostatic field between two coaxial cylinders forming an image at the surface of the inner cylinder has been calculated. The influence of the emission angle, the widths of the slits, and the size of the conical source on the energy resolution and on the transmission have been computed. (auth)

2641 NEW SECTOR TYPE DOUBLE FOCUSING BETA-RAY SPECTROMETER. Yamamoto, H. (Hitachi Central Re-

search Lab., Kawasaki, Japan); Takumi, K.; Ikegami, H. Nucl. Instrum. Methods, 65: 253-73(Nov. 15, 1968).

The design, construction and performance of a new sector type double focusing beta-ray spectrometer are described. Optimum performance has been investigated empirically. The spectrometer has a mean radius of 34 cm and a maximum transmission of 1.5% of 4π. Resolution of 0.08% has been obtained with a source 1 mm wide and 10 mm high. It should be noted that a luminosity-resolution relation of the SDF spectrometer is preferably compared with that of conventional $\pi\sqrt{2}$ spectrometers. An electron trajectory in the fringing field and the focal line have been also studied both theoretically and experimentally. It has been emphasized that the spectrometer is also suited for spectrographical use with multi-detectors as well as for measurements of electron-gamma and electron-electron angular correlation. (auth)

High Energy Physics Instrumentation

Refer also to abstract 2726.

2642 (CERN-68-37) DOLL: THE ON-LINE MEASUREMENT SYSTEM FOR HEAVY-LIQUID BUBBLE CHAMBER PHOTOGRAPHS. Soop, K. (European Organization for Nuclear Research, Geneva (Switzerland)). Oct. 18, 1968. 106p. Dep.

The DOLL (Decoding On-Line Logic) system for the on-line measurement of bubble chamber photographs is described. The DOLL system utilizes a CDC 3100 computer on-line with manually operated photograph measuring devices. (B.G.D.)

2643 (COO-1195-147) A STUDY OF THE HIGH-ENERGY PHYSICS GROUP COMPUTER NEEDS. Technical Report 174. Brown, R. M.; Sard, R. D.; Scharf, G. T. (Illinois Univ., Urbana. Dept. of Physics). Oct. 1968. Contract AT(11-1)-1195. 22p. Dep. CFSTI.

An analysis is made of the research operations and costs of the High Energy Physics Group with particular emphasis on the projected computer requirements arising from the DOLLY bubble chamber film measuring system and the Sigma 2 spark chamber data acquisition computer. The current costs per computer hour and per analyzed event are seen as strongly limiting factors in the future research plans. Acquisition of a computer system to process DOLLY output on-line and event analysis off-line is proposed. Analysis of the projected costs of such a system indicate that: at a funding level comparable to the FY 68 operations budget, the proposed computer system would support an increase in bubble chamber event through-put from the FY 68 total of 116,000 to 250,000 events per year; the tripling of computer requirements anticipated by the spark chamber group in its use of the Sigma 2 data acquisition computer could also be met within the current computer budget; and at full utilization the proposed computer system would process the maximum output of DOLLY-500,000 events per year-with an increase in total operations budget of $220,000. (auth)

2644 (RHEL/R-168) METHOD OF EXPLOSION VENTING A BUILDING. Simmonds, G. E.; Harrison, D. A. (Rutherford High Energy Lab., Chilton (England)). July 1968. 11p. Dep. CFSTI. UK 2s. 6d.

Buildings which house plants containing large amounts of liquid propane require special treatment to minimize the risks which can arise. A method is described for achieving the necessary venting should the propane leak and explode. (auth) (UK)

2645 IMPROVEMENTS IN OR RELATING TO A METHOD FOR REPRODUCING PICTURES. Beauval, Jean-Jacques; Lechauguette, Guy (to Commissariat a l'Energie Atomique). British Patent 1,133,552. Nov. 13, 1968. Priority date Mar. 17, 1966, France.

A method of photographically producing from a master negative displaying dark lines on a transparent background such as photographic pictures of particle tracks and nuclear events occurring in a bubble chamber is presented. (B.G.D.)

2646 METHOD OF SPARK CONTROL AND SYSTEMS FOR THE UTILIZATION OF SAID METHOD IN SPARK CHAMBERS. Lansiart, Alain; Leloup, Jean; Morucci, Jean-Pierre; Roux, Georges (to Commissariat a l'Energie Atomique). British Patent 1,133,682. Nov. 13, 1968. Priority date Nov. 27, 1965, France.

A method for controlling the discharges in a spark chamber used for localizing beta particles, gamma radiation, and x radiation is presented. (B.G.D.)

2647 NEW TECHNIQUE OF TRACK COUNTING TO MEASURE THE INTERACTION CROSS SECTION OF EMULSION TO HIGH ENERGY PARTICLES. Lee, Yung Jae (Atomic Energy Research Inst., Seoul). J. Nucl. Sci. (Seoul), 8: Pt. 1, 1-4(Aug. 1968).

A new technique of measurement with nuclear emulsion is introduced. When a well collimated high energy particle beam is available, the total interaction cross section can easily be measured by this method of track counting. The proposed method is applied for the measurement of the total cross section of emulsion for 10-GeV proton beam. By measuring the transmission of the beam using track counting method, the total section is found to be 425.6 mb. An estimation is also given for the elastic cross section as 62.9 mb subtracting an estimated value of inelastic cross section from the total cross section utilizing Williams empirical formula for the inelastic cross section. (auth)

2648 SCANNING TABLE FOR PHOTOGRAPHS FROM LARGE BUBBLE CHAMBERS. Vattenbakh, K.; Grebsh, V.; Novatski, G.; Poze, R. A. (Inst. of High Energy Physics, Berlin). Prib. Tekh. Eksp., No. 4, 41-3(July-Aug. 1968). (In Russian).

A table for scanning photographs from large bubble chambers is described. The screen projects simultaneously up to four stereo representations from one bubble chamber or two stereo representations from two different experiments. The maximum dimension of the photographs was 80×140 mm^2. The design of the projector was based on maximum personnel convenience and minimum damage to film. (tr-auth)

2649 SEMIAUTOMATIC APPARATUS FOR CAMERA PHOTOGRAPHS FROM BUBBLE CHAMBERS. Lyaiste, R.; Lippol'dt, Kh.; Poze, R. A. (Inst. of High Energy Physics, Berlin). Prib. Tekh. Eksp., No. 4, 44-6(July-Aug. 1968). (In Russian).

An apparatus for measuring coordinates of charged particle tracks on bubble chamber photographs is described. The points are automatically measured and recorded on punched cards. (tr-auth)

2650 MEASURING PROJECTOR FOR THE TREATMENT OF PHOTOGRAPHS FROM BUBBLE CHAMBERS. Kirst, Kh.; Kun, K.; Lippol'dt, Kh.; Novatski, G.; Poze, R. A.; Tom, Kh.; Khain, P. (Inst. of High Energy Physics, Berlin). Prib. Tekh. Eksp., No. 4, 46-8(July-Aug. 1968). (In Russian).

A projector for measuring the coordinates of charged particle tracks in bubble chambers with automatic recording on punched paper tape is described. In comparison with semiautomatic microscopes this projector has many advantages. (tr-auth)

2651 APPARATUS FOR MEASUREMENT OF IONIZATION OF CHARGED PARTICLES IN BUBBLE CHAMBERS. Battenbakh, K.; Kaufmann, Kh.; Poze, R. A. (Inst. of High Energy Physics, Berlin). Prib. Tekh. Eksp., No. 4, 49-50(July-Aug. 1968). (In Russian).

An apparatus for measurement of ionization of charged particles in bubble chambers from photographs is described. With this apparatus one can measure the total length $L - NX_0$, where N is the number of discontinuities and X_0 is the calculated minimum length of discontinuity. (tr-auth)

2652 CYLINDRICAL SPARK CHAMBER OF HIGH PRESSURE. Alakoz, A. V.; Babushkina, O. P.; Bolotov, V. N.; Devishev, M. I.; (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 4, 51-4 (July-Aug. 1968). (In Russian).

A spark chamber, the electrodes of which are arranged in the form of coaxial cylinders is described. Photographs are given which demonstrate particle tracks in relation to pressure and the composition of the working gas in the chamber. Particle track characteristics changed with an increase of pressure up to 42 atm and upon using different gases. An attempt was made to increase the isotropism of the spark chamber using a spherical configuration of electrodes. (tr-auth)

2653 THRESHOLD CHERENKOV COUNTER FOR RECORDING OF THE ULTRAVIOLET PART OF THE SPECTRUM. Blagorodov, A. M.; Vladimirskii, V. V.; Kukavadze, G. M.; Kuznetsov, B. Ya.; Novikova, N. V. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 4, 59-65(July-Aug. 1968). (In Russian).

A threshold Cherenkov counter for recording the ultraviolet part of the spectrum is described. The length of the counter is 3 m and the resolution is 8×10^{-5}. The counter was tested with π^- mesons with momentum 3.0 GeV/c. (tr-auth)

2654 EXPERIMENTAL INVESTIGATION OF THE GROWTH OF BUBBLES IN A BUBBLE CHAMBER. Kunkel, P.; Christenn, G.; Scheer, M. (Univ., Wuerzburg, Ger.). Z. Angew. Phys., 25: 329-31(Nov.-Dec. 1968). (In German).

The growth of bubbles is experimentally investigated in the sensitive region of the chamber liquid propane. The method is based on the measurement of bubble density as a function of time delay, from which the rates of growth can be determined by a simple statistical procedure. The bubble growth obtained is in good agreement with the theoretical prediction. Conclusions are drawn on the primary bubble densities. (auth)

2655 CHARACTERISTICS OF MAGNETOSTRICTIVE WIRE SPARK CHAMBERS. De Blasi, M.; De Marzo, C.; Giannelli, G.; Marangelli, B.; Ricco, M. (Univ., Bari, Italy. INFN, Bari, Italy). Nucl. Instrum. Methods, 65: 274-6(Nov. 15, 1968).

A spark chamber which gives both coordinates of the spark with a single plane of wires has been studied. While gas fillings of helium and neon-helium have been found unsuitable, good results have been obtained with argon and helium-argon mixtures. The velocity of the pulses in the wires is measured for every pulse, using the pulse reflected at one end of the wires. It has been found that hard-drawn wires give signals of better shape and of amplitude less variable with the tension of the wire, than the half-annealed wires. (auth)

2656 THE OGO-5 SPARK-CHAMBER TELESCOPE FOR GAMMA-RAY ASTRONOMY. Dean, A. J.; Hutchinson, G. W.; Ramsden, D.; Taylor, B. G.; Wills, R. D. (Univ. of Southampton, Eng.). Nucl. Instrum. Methods, 65: 293-300(Nov. 15, 1968).

A gamma-ray telescope incorporating an acoustic spark chamber is described. The instrument is included in the payload of the OGO-5 spacecraft which was launched into an eccentric earth orbit on March 4, 1968. The results of preflight laboratory tests are presented and discussed. It is shown that the instrument has an angular resolution of 3° and is capable of resolving a point source of intensity 3×10^{-6} photon/cm^2·sec after one month's operation in orbit. (auth)

2657 CERAMIC THYRATRON WIRE SPARK CHAMBER PULSER. Friend, B. (CERN, Geneva). Nucl. Instrum. Methods, 65: 311-13(Nov. 15, 1968).

A triggered high-voltage pulse generator with 1000 A output capability has been developed for use with wire spark chambers. It has short delay and rise times, a high repetition rate and a long lifetime. (auth)

Radiation Dosimeters

Refer also to abstract 4322.

2658 (AD-670591) BERYLLIUM OXIDE AS A THERMOLUMINESCENT DOSIMETER. Tochilin, Eugene; Goldstein, Norman; Miller, William G. (Naval Radiological Defense Lab., San Francisco, Calif.). Apr. 17, 1968. 26p. (USNRDL-TR-68-48). CFSTI.

The following dosimetric properties were observed in sintered BeO disks and powder: high thermal sensitivity and wide dynamic range, little energy dependence at low x-ray energies, low fast and thermal neutron thermoluminescence response and good stability at room temperature. Thermoluminescence is principally in the ultraviolet and can be optically stimulated by visible light. The response is linear from 10 mR to 50 R and can be measured up to 100,000 R. (auth) (USGRDR)

2659 (AEEW-M-801) THE MEASUREMENT OF PERSONNEL NEUTRON DOSE IN THE ENERGY REGION 0.5eV TO 10MeV WITH THERMOLUMINESCENT LITHIUM FLUORIDE. Preston, H. E. (Atomic Energy Establishment, Winfrith (England)). Aug. 1968. 12p. Dep. CFSTI. UK 2s. 6d.

A personnel dosimeter for the measurement of the total neutron dose primarily in the energy region 0.5 eV to 10 MeV is described. The dosimeter employs the very high thermal neutron response of TLD 600 LiF to measure the thermal neutron flux reflected from the body when exposed to neutrons of higher energies. (auth) (UK)

2660 (AEEW-R-607) READING EQUIPMENT FOR THERMOLUMINESCENT DOSIMETRY. Perry, K. E. G. (Atomic Energy Establishment, Winfrith (England)). July 1968. 15p. Dep. CFSTI. UK 2s. 6d.

A thermoluminescent reader used routinely for the measurement of finger tip doses is described. It covers a wide range of dose measurement and employs mainly commercially available electronic units in modular form. A more recent design of the measuring head, which is still under development, is suitable for use with solid forms of disc dosimeters as well as with loose LiF powder. (U.K.)

2661 (ANL-7454) CALCULATION OF dE/dx AND ENERGY LOSS DISTRIBUTIONS IN SPHERICAL CAVITIES FOR MONOENERGETIC NEUTRON FIELDS. Dvorak, Robert F. (Argonne National Lab., Ill.). May 1968. Contract W-31-109-eng-38. 19p. Dep. CFSTI.

A computer program has been prepared that calculates the average dE/dx and energy loss for events occurring in a spherical cavity due to incident monoenergetic neutrons. No assumptions are made as to distribution of path lengths. The particle paths are traced and a range-energy equation is used to calculate the cavity energy loss and average dE/dx for each event. The distribution in pulse height for events having the same average dE/dx is shown to be a function of both average dE/dx and the neutron energy, and to deviate from the commonly postulated triangular distribution at neutron energies below 1 MeV for a cavity with a diameter of 2.08 μm. Pulse-height distributions and dose distributions in average dE/dx for several energies have been computed. From the pulse-height distributions, LET distributions were calculated by the Rossi-Rosenzweig technique and compared with the computed average dE/dx distribution. The weighting factor relating energy loss and deposited dose equivalent for an event, as used with the survey instrument proposed by Baum, was also computed. It is shown to be dependent on the neutron energy, and to vary by as much as a factor of three in a region of heavy-event population. (auth)

2662 (DP-1006(Rev.1)) SAVANNAH RIVER PLANT CRITICALITY DOSIMETRY SYSTEM. Wright, Charles N.; Hoy, John E.; Splichal, William F. Jr. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Nov. 1965; Revised Sept. 1968. Contract AT(07-2)-1. 23p. Dep. CFSTI.

Fissionable materials are handled and processed at the Savannah River Plant. Although the probability of an accidental criticality occurring is small, the possibility must be considered. The methods which would be used to segregate exposed and nonexposed personnel and to determine neutron and gamma doses received by those who were exposed are described. (auth)

2663 (NP-17612) AUTOMATION OF A NUCLEAR EXPERIMENT ON THE 4-MeV ELECTROSTATIC ACCELERATOR OF THE FTI OF THE ACADEMY OF SCIENCES, USSR. PART II. Yamitskii, V. A.; Kopanets, E. G.; Korda, Yu. S.; Tsytko, S. P.; Zeidlits, P. M. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1967. 97p. (In Russian). Dep.

The selection rules for electric and magnetic transitions are presented in summarized form for the single-particle approximation and for the generalized model of the nucleus. The photoefficiency of a NaI crystal is analyzed mathematically by a Monte Carlo method and the theoretical results are compared with experimental values. Experimental pulse distributions are analyzed on the Dnepr digital computer after suitable mathematical treatment and programming of the subject. Complex gamma spectra are resolved according to the areas under the peaks. Experimental results are given for the $^{26}Mg(p,\gamma)^{27}Al$ reaction at E_p = 2293 and 2322 keV. Details of the program used on the computer are given. (TTT)

2664 (NSJ-tr-125) RADIATION DOSIMETRY BY POLYETHYLENE TEREPHTHALATE. Oshima, Yunosuke; Tanaka, Ryuichi. Translated from Oyo Butsuri, 36: 515-20(1967). 14p. Dep.

Use of polyethyleneterephthalate (PETP) film for radiation dosimetry of electrons is studied. For this purpose 100 μ PETP films were used and the annealing condition was studied. The samples were irradiated by a 2-MeV electron beam generator at a distance of 40 cm from the window. It is suitable to treat the film at 100°C for about an hour after the irradiation. The reproducibility is good by the heat-treatment, because the transient component of the coloration by irradiation disappears by this treatment and leaves only the permanent one. It is possible to use this dosimeter within a dose range from 2 Mrad to 50 Mrad. Fading characteristics of radiation induced coloration of PETP film were also studied. (auth)

2665 (SLAC-PUB-500) USE OF THERMOLUMINESCENT DOSIMETERS IN HIGH ENERGY HEALTH PHYSICS. Svensson, G. K.; McCall, R. C.; Jenkins, R. M.; Nelson, W. R. (Stanford Linear Accelerator Center, Calif.). Sept. 1968. 21p. (CONF-680920-7). Dep. CFSTI.

From 2nd International Conference on Luminescence Dosimetry, Gatlinburg, Tenn.

The use of thermoluminescent dosimeters around a 20-GeV electron accelerator is discussed. Advantages over other types of dosimeters, problems of calibration and interpretation of results, and fabrication techniques are described. Application to the measurement of electromagnetic showers, electron and muon scattering, bremsstrahlung distributions, beam profiles, etc., are presented. (auth)

2666 MEASUREMENT OF HIGH GAMMA DOSES BY AN AIR-WATER SYSTEM. Gomez, M. Barrachina; Alonso, M. Gomez (Junta de Energia Nuclear, Madrid). An. Fis., 64: 207-14 (July-Aug. 1968). (In Spanish).

Gamma irradiation of the air-water system yields HNO_3 as the main product. The behavior of that system exhibits some of the features desirable in a chemical dosimeter: it is stable under normal conditions, easy to prepare, simple to use and its response is linear within a wide dose range. The dosimeter con-

sists of 1 ml bidistilled water and a known amount of dry air, both contained in a sealed Pyrex bulb. Sample irradiations have been performed in the JEN's NAYADE source (about 7 KCi of ^{60}Co) and NO_3^- determinations were carried out by standard spectrophotometric methods. Analytical results show that the response of the system (amount of NO_3^- ion/initial amount of N_2) is independent of air-water phase ratio, air pressure and dose rate effects and proportional to radiation dose up to 400 Mrad at least, with a $G_{NO_3^-}$ value (relative to the energy absorbed in the gaseous phase) of 2.06 ± 0.11. This value refers to irradiations at 20°C and a Fricke G value of 15.5. (auth)

2667 NEUTRON AND GAMMA-RAY DOSIMETRY IN REACTOR MEASUREMENTS. Tochilin, E. (Naval Radiological Defense Lab., San Francisco). Trans. Amer. Nucl. Soc., 11: 462 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2668 DYE SYSTEMS FOR DOSIMETRY OF INTENSE RADIATION FIELDS. McLaughlin, W. L. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 460-2 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2669 THERMOLUMINESCENT RADIATION DOSIMETRIC MATERIAL. Jones, Donald E.; Gaskill, James R. (to United States Atomic Energy Commission). U. S. Patent 3,413,235. Nov. 26, 1968.

A thermoluminescent material for use in radiation dosimetry is described which consists essentially of crystalline lithium fluoride doped with 0.4-0.6 mole % of europium and 1.02-1.04 mole % of magnesium, and has a high sensitivity to low radiation dose rates in the range of 10–100 milliroentgens for personnel dosimetry. (AEC)

2670 A METHOD AND MEANS UTILIZING A PULSED ULTRAVIOLET LASER BEAM FOR READOUT OF PHOTOLUMINESCENT DOSIMETERS. Kastner, Jacob; Eggenberger, Delbert N.; Voyvodic, Louis (to United States Atomic Energy Commission). U. S. Patent 3,412,248. Nov. 19, 1968.

A dosimetry readout system for photoluminescent material is described. It includes a pulsed ultraviolet laser beam focused upon the photoluminescent material whose output is detected by a first photomultiplier. Using a slotted mirror, the pulse ultraviolet laser beam is also transmitted to a second photomultiplier whose output is delayed in time and fed to the first photomultiplier to control the operation thereof. The output of the second photomultiplier is delayed in time a period which is equal to the duration of the output pulse of the laser beam plus a duration greater than the time required for the decay of the component of the visible fluorescence of the photoluminescent dosimeter which is due to the predose or fluorescent background of the dosimeter. The output of the first photomultiplier, which is proportional to the radiation to which the photoluminescent material has been exposed, is then recorded. (AEC)

2671 ON THE APPLICABILITY OF A SOLID STATE BRAGG–GRAY CAVITY CHAMBER TO THERMOLUMINESCENT DOSIMETRY. Nakajima, Toshiyuki (National Inst. of Radiological Sciences, Tokyo). Int. J. Appl. Radiat. Isotop., 19: 789-94 (Nov. 1968).

An attempt was made to construct a solid state analogue of a Bragg–Gray cavity chamber. The theoretical thermoluminescent intensity in the phosphor-filled cavity was deduced by applying the theory of Cormack and Johns. Thin films (about 30 micron) of $CaSO_4$(Mn) thermoluminescent phosphors were placed between walls of C, Al, Cu, Mo, Cd, W, or Pb and irradiated. Results in ^{60}Co γ-ray fields indicated that the Bragg–Gray theory can be approximately applied to thermoluminescent dosimeters of thin film phosphors. The measurable minimum dose for $CaSO_4$(Mn) film phosphors was about 10^{-3} rad. (auth) (UK)

2672 STATISTICAL ANALYSIS OF DATA FROM FILM BADGE PERFORMANCE TESTS. Barber, Donald E.; Brown, Byron W.; James, Kenneth E. (Univ. of Minnesota, Minneapolis). Contract PH 86-63-198. Amer. Ind. Hyg. Ass. J., 29: 482-9 (Sept.-Oct. 1968).

Data on tests of film badge services have been analyzed statistically to determine the probability that services may be expected to meet performance criteria developed under the auspices of the National Sanitation Foundation (NSF). These criteria were derived empirically on the basis of a single sample of film badge services in the United States. Ten film badge services participating in the NSF seal of approval program released their data for this analysis. The study compares the empirical criteria and statistical expectations based on newly available data. The implications of the analysis for future film badge performance criteria are also discussed. (auth)

2673 ZONE DOSIMETRY IN NUCLEAR DISASTER. Francois, H. (CEA, Paris); Pradel, J.; Carpentier, S.; Delarue, R. Energ. Nucl. (Paris), 10: 319-24(Sept. 1968). (In French).

Reference is made to the symposium on "Radiological Protection of the Public in a Nuclear Mass Disaster" which took place in Interlaken May 26–June 1, 1968. The previous work of Japanese experts who used the thermoluminescent properties of roof tiles in Hiroshima and Nagasaki in order to evaluate the doses around the explosion sites is described. It is then shown that a new thermoluminescent ceramic material gives the Civil Defense Organizations an operational means for zone dosimetry at a low cost and with a good precision compatible in case of a so-called maxi catastrophe. (auth)

2674 STATISTICAL FLUCTUATIONS OF ENERGY DEPOSITED BY PROTONS IN THIN LAYERS OF LOW ATOMIC NUMBER MATERIALS: MICRODOSIMETRIC APPLICATIONS. Hilbert, Jerald William. Los Angeles, Univ. of California, 1968. 168p.

Thesis.

A low-pressure, gas-flow, proportional counter has been used to simulate volumes of biological interest (as small as ≅ one micron), and energy-deposition distributions due to high energy protons have been measured for a variety of simulated volumes and irradiation conditions. In addition to the primary objective of obtaining microscopic energy-deposition distributions which can be used in conjunction with biological experiments to examine models of radiation damage, an interesting secondary result has been a partial verification of some aspects of the corrected energy-loss theory which must be used for very small mean energy losses, when the effects of losses to bound electrons become important. The experimental approach and the physical and biological implications of the resulting microdosimetric distributions are discussed in some detail. (Disser. Abstr.)

2675 TRIPLET SAMPLED RADIATION DAMAGE. Weisz, S. Z. (Puerto Rico Nuclear Center, San Juan); Richardson, P.; Cobas, A.; Jarnagin, R. C. Mol. Cryst., 4: 277-92(1968).

From Symposium on Organic Scintillators, Argonne, Ill. See CONF-660612.

The emission produced by mutual annihilation of a pair of triplet excitons in single crystalline anthracene was observed to be an indicator of low level γ-ray dose. Under steady red light illumination the blue emission intensity F_T is related to γ-ray dose D by $F^{-\frac{1}{2}} = a + bD$ in the range 300 R to 10^4 R. Independent measurements show the effect cannot be due to changes in absorption in the red region, changes in quantum yield of fluorescence, nor to changes in the specific rate of triplet interaction. An interpretation based on radioinduced quenchers and the long range of triplet excitons is given. By use of multiple techniques an individual single crystal of anthracene can be used as a wide-range dosimeter: triplet-triplet annihilation in the range 10^2 to 10^4 R, space charge limited photo-current in the range 10^3 to 10^6 R, fluorescence quenching in the range 10^5 to 10^8 R, and absorption spectroscopy above 10^7 R. (BBB)

2676 CALORIMETRIC DOSIMETRY OF FISSION NEUTRONS AND γ-RAYS. Terekhin, V. A.; Poretskii, L. B. At. Energ. (USSR), 25: 156(Aug. 1968). (In Russian).

Adsorbed doses were measured calorimetrically in samples of lead, teflon, and polyethylene which were placed in a reactor channel or in a critical ^{235}U assembly. The calorimeter was a Dewar flask containing a cylindrical sample with an attached thermocouple to read the temperature rise in the sample. On assuming an average prompt gamma energy of 1.1 MeV it is calculated that the gamma dose in teflon is 84% of the gamma dose in polyethylene. Similarly the neutron dose in teflon was only 8% of the neutron dose in polyethylene. By this means it was found that the neutron contribution to the total dose was 25 to 40% at the boundary between the core and the reflector, while it was 60 to 80% of the total dose in a critical ^{235}U assembly or in a fast neutron reactor. (TTT)

2677 GAMMA-RAY THERMOLUMINESCENCE IN RARE-EARTH-ACTIVATED Y_2O_3 PHOSPHORS. Ato, Yasuro (Government Industrial Research Inst., Nagoya, Japan); Huzimura, Ryoitiro; Ozawa, Lyuji. Jap. J. Appl. Phys., 7: 1497-1503(Dec. 1968).

The gamma-ray- and photo-induced thermoluminescences in rare-earth-activated Y_2O_3 phosphors are investigated. They have three or four peaks between 85 and 380°K. The efficiency of thermoluminescence in Y_2O_3: Eu is highest among the phosphors examined, being about ten times of those of the others. The main peak temperature of gamma-ray-induced thermoluminescence in Y_2O_3 activated by Eu or Dy is shifted about 10°K from that of photo-induced thermoluminescence. The emission colors

in gamma-ray-induced thermoluminescence in Y_2O_3: Eu and Y_2O_3: Dy were inferred to be due to the proper photo-luminescent band of Eu^{3+} and Dy^{3+}, respectively. A broad white-like emission band was found for the lowest temperature peak of unactivated Y_2O_3. The effects of the heating rate for the present thermoluminescence are the same as in the usual phosphors. The activation energy was 0.996 eV for the highest temperature peak (348°K) of Y_2O_3: Eu. The growth and fading of this peak after gamma-irradiation at room temperature nearly obey monomolecular kinetics. The effect of radiation damage on the growth of the peak became remarkable with doses near 10^4 R. The mechanism of the thermoluminescence and its applicability to radiation dosimetry are discussed. (auth)

2678 DOSIMETER INCORPORATING AN ELECTROCHEMICAL INTEGRATING DEVICE. Lakin, Roger W. (to United States Atomic Energy Commission). U. S. Patent 3,405,274. Oct. 8, 1968.

A dosimeter featuring an electrochemical integrator to receive, integrate, and store analog signals derived at the output of a Geiger–Mueller counter, including a compensation network to enhance count rate frequency response capability, is described. (AEC)

Radiometric Instruments

2679 LOW COST, AUTOMATIC, NEST AND BURROW MONITOR USING RADIOACTIVE TAGGING. Frigerio, Norman A.; Eisler, William J. Jr. (Argonne National Lab., Ill.). Ecology, 49: 788-91(Early Summer 1968).

An automatic, transistorized nest and burrow monitor is described which is low in cost, portable, self-contained and weatherproof. Each unit monitors 4 locations to a diameter of 32 m, each animal up to 1 m from its detector. Permanent weekly records are provided for each channel. Gamma rays from a tag on the animal are detected by miniature GM tubes. These are presented as counts on small, electric-pen recorders. While any gamma-emitting radionuclide can be used, certain ones are recommended by reason of their half-lives, gamma energies, and low radiation dose to the animal. (auth)

2680 ON THE PROBLEM OF FALSE READINGS IN RADIOMETRIC CONTROL OF SHEET THICKNESS. Schuricht, V. (Technical Univ., Dresden). Isotopenpraxis, 4: 230-1(June 1968). (In German).

The probability of false readings in the radiometric control of sheet thickness was calculated as a function of $\sqrt{N_0/2\mu\rho\Delta}$. The results are shown graphically for various parameter values. (J.S.R.)

2681 THE USE OF NUCLEAR METERS IN SOILS INVESTIGATIONS: A SUMMARY OF WORLDWIDE RESEARCH AND PRACTICE. Smith, P. C.; Johnson, A. I.; Fisher, C. P.; Womack, L. M. ASTM Special Technical Publication No. 412. Philadelphia, American Society for Testing and Materials, 1968. 142p. $8.75.

Questionnaires circulated throughout the world provided information on research and practice in the use of nuclear meters for moisture and density measurements in soils. The study was sponsored by Committee D-18 on Soil and Rock for Engineering Purposes, American Society for Testing and Materials. Information was received from equipment manufacturers and users of the equipment in government agencies, private companies, and universities in the agricultural, engineering, hydrologic, and geologic disciplines; this information was received from 13 foreign countries and the United States. Equipment produced by various manufacturers is described, health and safety in the use of such equipment are considered, and procedures followed by users in applying nuclear meters to the measurement of the moisture and density of rock and soil materials are discussed. The limitations and accuracy of test results are described; research involving use of nuclear meters is summarized; and an extensive bibliography of published literature is presented. (auth)

2682 A NUCLEONIC STATIONKEEPER FOR HELICOPTERS. Wilcox, George E. (Naval Air Development Center, Warminster, Pa.). Trans. Amer. Nucl. Soc., 11: 427-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2683 THICKNESS GAUGE USING β-SOURCE. Haque, Meah M. S.; Chowdhury, R. K.; Ahmed, Y.; Ahmed, N. U.; Dutt, J. C.; Islam, H. Nucl. Sci. Appl., 4: 50-4(Apr. 1968).

A portable transistorized β-ray thickness gauge of transmission type for the determination of thickness of paper has been developed and the results are reported. This instrument will be found useful in paper industries for quality control. The electronic circuitry has been found to be linear over the range 0.05 to 0.70 mg/cm² with an accuracy better than 1.5% up to about 0.5 mg/cm² and within 2.9% above 0.5 mg/cm². (auth)

2684 APPLICATION OF X FLUORESCENCE TO POSTAL SORTING. Gerbier, G.; Robin, G. Energ. Nucl. (Paris), 10: 303-7(Sept. 1968). (In French).

In the post office, the sorting is preceded by the mail straightening operation. The latter is mechanized and a detector finds the position of the stamp on the envelope and consequently commands the metallic pieces of the machine. A prototype of a detector using the fluorescence of x rays produced by a radioactive source was achieved. The source is promethium 147 on an aluminum target which emits braking x rays. The paper of the stamp contains a charge with zinc oxide. The characteristic x ray of zinc is detected and signals the presence of the stamp. The apparatus works at the speed of 36,000 letters per hour, and detection goes on with a very small error degree. The performances of this apparatus have satisfied the technical requirements of the Post Office Administration. (auth)

2685 CORRECTION FOR DRY BULK DENSITY IN MEASUREMENTS WITH NEUTRON MOISTURE GAUGES. Nagy, A. Z.; Vertes, P. (Central Research Inst. for Physics, Budapest). J. Phys., E (London), 1: 1097-1100(Nov. 1968).

The systematic error induced in the readings of neutron moisture gauges by variation in the dry bulk density of the medium is investigated theoretically. In order to obtain the correction for dry bulk density two independent measurements must be performed. The correction is calculated by means of three-group theory, with group constants evaluated from multigroup moment equations. (auth) (UK)

2686 IRRADIATION-TYPE GAMMA-RAY LEVEL GAGE. Inoue, Yoichiro; Sakaki, Masamichi (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rebyu, 23: 1306-12(Oct. 1968). (In Japanese).

Toshiba irradiation-type gamma-ray level gage, AEL-75401, incorporates a glass-rod radiation source developed at the Central Research Laboratory and a high-sensitivity scintillation gamma-ray detector. The radiation source is a porous high-silica glass rod that has absorbed radiation source material and has been solidified by sintering. With this type of source, it is possible to obtain a continuous, lengthy source having any intensity distribution as desired; therefore a source can be so formed as to best conform with the shape of the vessel and the geometry of the detector in regard to the intensity distribution; response of the level gage can be made perfectly linear. The prominent features of this gage may be summarized as follows: the intensity distribution of the source, selected freely, brings linear response irrespective of the shape of the vessel; the source with continuous intensity distribution has no pulsation in its response unlike the multiple-source irradiation; measurement can be accomplished with a comparatively small amount of the source material; the gage, having smooth response (with no pulsation), demonstrates excellent control characteristics when used as an automatic control element; and dispensing with the linearizer, it assures perfect interchangeability in its application to electrical instruments, such as the converter, controller, recorder, etc. (auth) (NSA of Japan)

Miscellaneous Instruments and Components

Refer also to abstracts 2464, 2547, 2848, 3557, 4305, and 4316.

2687 (67-C-278) CHARACTERISTICS AND SOURCES OF COMMERCIALLY AVAILABLE LEAK DETECTORS. Bialous, A. J. (General Electric Co., Schenectady, N. Y. Research and Development Center). July 1967. 160p.

A program has been conducted to determine the commercial availability and characteristics of the various types of leak detecting equipment. Characteristics and sources of each of the commercially available equipments have been compiled and presented in a tabular form on individual data pages. Eighty-two vendors have contributed useful information. Twenty-two different principles of measurement are used by these vendors. Several cross-indexing tables have been developed to serve as a guide for specific types of detecting equipment and their manufacturers. This report serves as a supplement to the "Leakage Testing Handbook" prepared for the National Aeronautics and Space Administration (S-67-1014) which has been written for this program by Dr. J. W. Marr. (auth)

2688 (AERE-R-5844) SMALL COMPUTER USED AS A MULTI-CHANNEL ANALYSER. Lewis, A. (Atomic Energy

Research Establishment, Harwell (England)). July 1968. 8p. Dep. CFSTI. UK 2s. 6d.

A 2000 channel pulse height analyzer with 18-bit count capacity per channel is described. The hardware comprises a PDP-8 computer (4K–12-bit words) with DEC-tape, a control panel with switches and lamps to simulate a conventional analyzer, and uses computer independent peripherals (Prototype IANUS modules). The system is intended to work with Harwell 2000 Series nuclear counting equipment. (auth)

2689 (BMwF-FBK-68-27) INVESTIGATION OF AN OSCILLOGRAPHIC MEASURING METHOD FOR HIGH PULSED VOLTAGE OF A FEW NANOSECONDS. Pillsticker, M. (Technische Hochschule, Brunswick (West Germany). Hochspannungsinstitut). June 1968. 40p. (In German). Dep.

Investigations on the measurement of pulsed high voltage up to 100 kV and a few nanoseconds are reviewed. Such measurements are accomplished with a voltage divider and a cathode ray oscilloscope, connected with a coaxial cable. Relations of a cylindrical shielded low resistance divider are discussed. The transmitting conditions of the divider, cable and oscilloscope are calculated and measured. (auth)

2690 (BNWL–868) FAST PULSE SIGNAL AVERAGING. Wilson, W. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 26p. Dep. CFSTI.

A system which couples a sampling oscilloscope with a small digital computer is described. This combination makes it possible to digitally record very high frequency (up to 1GHz) and low-level (down to mV) electronic waveforms. By having the data in digital form in a computer, it is possible to do elementary calculations on individual waveforms or process many repetitions of a waveform (signal average). Some familiarity with sampling techniques and digital computers is assumed. (auth)

2691 (COO–1721-6) SIMPLE SCANNING ELECTRON MICROSCOPE. Crewe, A. V.; Isaacson, M.; Johnson, D. (Chicago Univ., Ill.). [1968]. 25p. (EFINS–68-73). Dep. CFSTI.

A simple scanning microscope has been built which uses a field emission electron gun alone, without the aid of auxiliary lenses. The design and operation of the microscope are described and the calculated performance is compared with experiment. Resolution of 100 Å has been obtained and is shown in transmission electron micrographs. The probe current is of the order of 10^{-10} to 10^{-11} A, a value which is high enough to allow micrographs to be taken with scan times of 10 seconds. (auth)

2692 (GEPP–43) OPERATING CHARACTERISTICS OF A DEVELOPMENTAL MODEL PORTABLE NEUTRON GENERATOR. Roubik, J. C.; Thompson, V. C. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). Sept. 11, 1968. Contract AT(29-2)-656. 31p. (R–68-ND-20). Dep. CFSTI.

This report evaluates the operating characteristics of a developmental model portable neutron generator. The average coefficient of variation is 1.15 percent for 60 out of 64 factor combinations, which means that the generator can be used as a correlation device. The generator requires approximately 30 minutes for output to stabilize under ambient temperature conditions of approximately 20°C. On an average, the output level of the generator is resettable to within –2.3 to –5.4 percent depending on the variable reset. If the required accuracy is no greater than this percentage range, the generator can be used as an equipment calibrator. A neutron output versus control setting calibration curve for the particular Controlatron used in this evaluation is also provided. (auth)

2693 (IDO–17259) CDC 3100 COMPUTER AS A REMOTE INPUT/OUTPUT TERMINAL FOR A UNIVAC 1108 COMPUTER SYSTEM. Seamons, Dwight C.; Gipson, Dick H. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Sept. 1968. Contract AT(10-1)-205. 109p. Dep. CFSTI.

A set of CDC 3100 computer programs used to transmit UNIVAC 1108 batch jobs from a CDC 3100 to a UNIVAC 1108 computer running under the EXEC II operating system was described. The 3100 is used as a remote input/output terminal linked to the 1108 via a voice grade telephone circuit. The programs are written so that the 3100 appears to the EXEC II operating system as a UNIVAC 1004 remote terminal. The 1108 batch jobs are read into the 3100 by the card reader, conditioned for transmission, and sent over a half duplex voice grade telephone circuit to the 1108 system. There they are received, spooled into the job input stack, processed, and the output for each job is sent back to the 3100 where it is listed and cards punched. The report describes character conversions, compression of card images, decompression of print-punch images, formatting, and message switching techniques used by the 3100 programs. The hardware used by the 3100 for data transmission is the CDC 3266-B Communications Terminal Controller, a CDC 311-B Data Set Adapter, and a Bell System 201A Data Set. The data transmission consists of eight bit characters at a rate of 2000 bits per second. (auth)

2694 (LA–3964) MODEL-10 PRECISION DELAY TRIGGER GENERATOR. Brousseau, A. T. (Los Alamos Scientific Lab., N. Mex.). Aug. 1968. Contract W-7405-eng-36. 10p. Dep. CFSTI.

The Model-10 Precision Delay Trigger Generator, which, together with its precursor models, has been used extensively throughout the Los Alamos Sherwood Project for the last ten years is described. The intent is to provide the user with an operating instructional manual. (auth)

2695 (LA–3975) LIGHT METER FOR P-16 PHOSPHOR CATHODE-RAY TUBES. Brown, Wilbur K. (Los Alamos Scientific Lab., N. Mex.). Aug. 12, 1968. Contract W-7405-eng-36. 4p. Dep. CFSTI.

A light meter is described that has been developed for setting the intensity of P-16 phosphor cathode-ray tubes. The light meter is used in the recording of time-of-flight neutron cross-section data in measurements using an underground nuclear explosion source. (auth)

2696 (NSJ-tr–135) DEVELOPMENT OF IN-CORE VOID METER. Satomi, Masahiro; Yusa, Hideo; Oda, Akira; Uga, Takeo; Mochizuki, Keiichi. Translated from Trans. Soc. Instrum. Contr. Eng., 3: No. 3, 229-35(Sept. 1967). 16p. Dep.

In order to measure steam void fractions in operating Boiling Water Reactors, two types of void-meters solenoid-type and digital-type, were developed. The former consists of a solenoid, a high frequency oscillator, a bridge and other suitable electric circuits and detects impedance change induced by voids passing through the solenoid. The latter uses a thin needlelike electrode as detecting head and detects the changes of capacitance and resistance induced when the electrode collides with and penetrates a bubble. Since the changes of impedances induced by void were very small, special electric circuits were also devised to detect the small signals. The solenoid type void-meter responds promptly with high sensitivity, and is suitable for measuring mean void fractions in the solenoid under transient conditions, while the digital type void-meter is small in size and is applicable to measuring time-averaged local void fractions. These performances were examined through out-pile experiments. The detecting heads of the void-meters were designed and manufactured with special considerations so as to be used under the conditions of high pressure and high irradiation. These void meters were used to measure void fractions in the chimneys and in the downcomer of operating reactor JPDR (Japan Power Demonstration Reactor; a boiling water reactor with natural circulation). (auth)

2697 (RISO-M–767) AUTOMATIC POTENTIOMETER SETTING PROGRAM FOR THE ANALOGUE COMPUTER EAI 680. Suusgaard, Chr.; Hoejberg, K. Soee (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1968. 12p. (R–21-68). Dep.

The program described is used for automatic setting of potentiometers in the analog computer EAI 680 by means of a paper tape via the PDP 8 digital computer and interface equipment. (Denmark)

2698 (RISO-M–768) CONTROL INTERFACE SYSTEM FOR EAI 680-PDP 8. Hoejberg, K. Soee; Suusgaard, Chr. (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1968. 15p. (R–22-68). Dep.

The control interface system described is primarily intended for the automatic potentiometer setting in the analog computer EAI 680 from the 12-bit digital computer PDP 8. (Denmark)

2699 (RISO-M–771) QUARTERLY REPORT OF THE ELECTRONICS DEPARTMENT FOR THE PERIOD JANUARY 1–MARCH 31, 1968. (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1968. 25p. (R–23-68). Dep.

A summary is given of department activities: automatic recording of meteorological data, burnout meters, hybrid computer calculation (HDT), and automatic testing of data cards based on logic circuits. (J.S.R.)

2700 (RISO-M–780) PDP 8 MAGNETIC DRUM TEST PROGRAM. Zamir, S. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug. 1968. 14p. (R–24-68). Dep.

The PDP 8 magnetic drum test program described tests the drum in a sequence selected by the user. (Denmark)

2701 (RT/EL-(68)8) INTERFACE BETWEEN EXPERIMENTAL NUCLEAR INSTRUMENTATION AND THE CONTROL SYSTEM. Babiloni, L.; Bevilacqua, S.; de Agostino, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 24p. (In Italian). Dep.

An interface system, designed in order to join nuclear instrumentation and control system, is described. This interface has been realized in view of its use in connection with a special purpose controller, but some special criteria adopted in its design will make it suitable for many other different automation problems, including general purpose computers. (auth)

2702 (SC-DR-67-850) LASER LIGHT DETECTING AND RANGING (LIDAR) SYSTEMS GB-60A AND GB-60B. Landry, M. J.; Lochner, J. R. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1968. 132p. Dep. CFSTI.

Sandia Laboratories has developed a laser light detecting and ranging (LIDAR) system, primarily for use in tracking and diagnosing clouds formed by the ablation of simulated SNAP heat source materials during atmospheric reentry tests. This report briefly describes the GB-60A, a first generation LIDAR, and describes in detail the GB-60B LIDAR which provides more real time tracking than does the GB-60A. (auth)

2703 (TRG-Report-1650) THE DESIGN AND CONSTRUCTION OF ACOUSTIC TRANSDUCERS FOR USE IN A.G.R. SIMULATION LOOPS. Rooney, J. (United Kingdom Atomic Energy Authroity, Springfields (England). Reactor Group). Feb. 26, 1968. 18p. Dep. CFSTI. UK 5s.

The design, construction, and calibration of acoustic transducers for use in out-of-pile testing of fuel elements are described. Some work on acoustic transducers for high-temperature operation above 250°C is discussed. (auth) (UK)

2704 (UCRL-18181) DESIGN AND USE OF A DATA LINK FOR HIGH-ENERGY PHYSICS EXPERIMENTS. Andreae, Sypko W.; Lafore, Robert W.; Kirsten, Frederick A. (California Univ., Berkeley. Lawrence Radiation Lab.). July 31, 1968. 10p. (CONF-680906-5). Dep. CFSTI.

From International Symposium on Nuclear Electronics, Versailles, France.

The use and operating characteristics of a data link between small on-line computers (PDP-5's) and a large batch-processing computer (Control Data 6600) is described. This link was constructed to permit access to the large central computer during the operation of high-energy physics experiments. This access allows the processing of portions of the experimental data on a nearly real-time basis. Certain design restrictions were imposed by the nature of the CDC 6600 and its normal mode of use. (auth)

2705 (UCRL-71222) RELIABILITY OF ELECTRICAL CABLES IN DOWNHOLE OPERATIONS. Zaslawsky, M. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 12, 1968. 38p. (CONF-680823-1). Dep. CFSTI.

From 15th Meeting of the IMOG Subgroup on Environmental Testing, Las Vegas, Nev.

Numerous coaxial cables used by LRL in the field (though not all) have been tested under temperature and load conditions. The effect of temperature alone or of temperature and load on electrical cables has not had any previous industry-wide attention. A facility for performing such tests, as well as abrasion tests, has been developed. To date, no cables which are satisfactory at 150°F or higher have been found. At these temperatures, the cable jacket elongates and squeezes through the Kellem grips when any load is applied. At room temperature, the electrical cables are quite satisfactory. At 300°F, under no load, only one cable (Ruggedized RG 213, propylene copolymer dielectric and jacket) appears to resist failure, i.e. the migration of the center conductor to the outer conductor. Unfortunately, Ruggedized RG 213 is not used on an exclusive basis. Attempts are being made to use fiberglass as an outer jacket, but this is in the future. Other cables not previously studied will require evaluation, and Ruggedized RG 213 will require further evaluation. (auth)

2706 INSTRUMENT FOR THE AUTOMATIC RECORDING OF COSMIC-RAY BURSTS. Kapustin, I. N. (Polar Geophysical Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 315-16(1968).

Translated from Geomagn. Aeron., 8: 387-8(1968).

Neutron supermonitors with a high statistical accuracy, with which the network of stations is equipped, makes it possible to study individual bursts in detail. The 5- and 15-min recording schedule adopted by the network makes it difficult to study rapid processes in the bursts and many of their details are blurred. Transition to a more frequent recording schedule is inadvisable, owing to the rarity of the phenomena, since it would lead to the appearance of a large amount of information which is difficult to process. As a compromise, an automatic system for detecting bursts and converting the recorder to a more frequent recording schedule is proposed. The time delay of the information, achieved by a tape recorder and the loop of magnetic tape, makes it possible to change to more frequent recording "prior to the beginning" of the burst, which is very important for the detailed study of the initial stage and for a more correct determination of the instant it begins. (W.D.M.)

2707 X-RAY MILLIPROBE ANALYSER WITH PHOTOGRAPHIC RECORDING OF THE SPATIAL DISTRIBUTION OF ELEMENTS. Campbell, J. T.; Garton, F. W. J.; Wilson, J. D. (Atomic Energy Research Establishment, Harwell, Eng.). Talanta, 15: 1205-16(Nov. 1968).

An x-ray milliprobe analyzer was built and its performance and usefulness evaluated. The instrument consists of a fluorescent x-ray spectrometer in which the primary x-ray beam from the sealed-off tube is collimated so that only a small area on the specimen, 0.3 or 1 mm in diameter, is irradiated. The large loss in intensity of the fluorescent x-rays is offset to some extent by the use of a focusing curved-crystal analyzer. The usefulness of the instrument was greatly increased by the incorporation of an automatic raster scanning motion in the sample holder, and of a similar motion in a color-film holder which moves across a light beam. The color of this beam is altered according to the measured concentration of the element, so that a colored mosaic picture of its distribution is built up. The limits of detection of a wide range of elements are in the range 200 to 2000 ppM for the rather short counting period of 10 sec per point which is necessary when scanning a large area. (auth)

2708 APPARATUS FOR THE DETERMINATION OF THE MEAN FREQUENCY OF A PHENOMENON WITH POISSON'S DISTRIBUTION. (to Skoda, Oborovy Podnik). British Patent 1,133,503. Nov. 13, 1968. Priority date Mar. 22, 1965, Czechoslovakia.

A circuit for indicating when the magnitude of the difference between an unknown frequency of a phenomenon with Poisson distribution and a standard periodic frequency exceeds a predetermined limit is described. (B.G.D.)

2709 MEASUREMENT OF SUPERFICIAL DENSITY OF THIN SELF-SUPPORTING METAL FILMS BY ELECTRON TRANSMISSION. Lovell, S.; Rollinson, E. (St. Bartholomew's Hospital, London). J. Phys., E (London), 1: 1032-5(Oct. 1968).

It is shown that the end point of the transmission–energy curve for electrons incident of thin films gives an acceptable measure of the film thickness. Apparatus is described by means of which this end point can be determined using an electron beam of approximately 0.5 m diameter. Calibration curves are presented for aluminium, copper, tin, and gold films ranging in thickness between 30 and 450 $\mu g\ cm^{-2}$. (auth)

2710 APPLICATION OF THE SLOWING DOWN TIME SPECTROMETER FOR THE CONTROL OF FISSIONABLE MATERIAL. Stegemann, D.; Seufert, H. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 658-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2711 ACOUSTIC HOLOGRAPHY FOR NUCLEAR INSTRUMENTATION. Hildebrand, B. P. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 633-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2712 HUMANOIDS: THE NEW REMOTE SYSTEMS TECHNOLOGY. Johnsen, Edwin G. (AEC-NASA Space Nuclear Propulsion Office, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 617(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2713 ERROR ANALYSIS OF A CALORIMETER FOR NUCLEAR HEATING MEASUREMENT. Burwell, D. L. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Amer. Nucl. Soc., 11: 463-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2714 ^{85}Kr SCINTILLATION DETECTOR FOR MEASURING SPACECRAFT LEAK RATES. Rusch, Roger J. (TRW Systems, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc., 11: 467(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2715 STUDY OF A BERYLLIUM MONOCHROMATOR FOR NEUTRONS. Diaz, L. Manas (Junta de Energia Nuclear, Madrid). An. Fis., 64: 81-91(Mar.-Apr. 1968). (In Spanish).

A beryllium single crystal has been studied in order to employ it in neutron diffraction. The [010], [110], [210] and [310] zones and their crystallographic planes have been determined. Their interplanar distances and structure factors have been calculated too. The better planes have been selected to measure cross sections. This selection has been made having in mind the maximum energy that can be obtained and the difference between the spectrum of diffracted neutrons for every plane and the background. Some discrepancies with the results given by other authors have been found. (auth)

2716 ANALYSIS OF GASES WITH AN ELECTRIC MASS FILTER. Lozano, J. (Junta de Energia Nuclear, Madrid). An. Fis., 64: 71-80(Mar.-Apr. 1968). (In Spanish).

An electric mass filter with a resolving power of 1/200 has been constructed and some measurements are shown. The relative abundance of the natural chlorine isotopes has been determined leading to the ratio $^{35}Cl/^{37}Cl = 3.22$, in agreement with the Kallman data. The partial pressure of the CO_2 is roughly proportional to the leak value. During the bake out when a leak is present, the CO_2 increases and the O_2 decreases as the temperature increases. This phenomenon is explained by the reaction $CO + \frac{1}{2}O_2 \rightarrow CO_2$ catalyzed by the OFe in the inner surface of the chamber. (auth)

2717 DIGITAL DATA SORTING LOGIC SYSTEM. Knutson, Richard E. (to United States Atomic Energy Commission). U. S. Patent 3,411,146. Nov. 12, 1968.

A digital data sorter is described for arranging numerical data from a digital readout device into a histogram presentation with storage registers responsive to numerical values in a fixed relation to a center value using selectively actuable switching means and logic circuits. (AEC)

2718 THERMIONIC EMISSION OF LEAD FROM ANNEALED OXIDES AND ITS UTILIZATION IN IONS SOURCES OF MASS SPECTROMETERS. Amov, B. G. Isotopenpraxis, 4: 358-63 (Sept. 1968). (In Russian).

With the aid of a mass-spectrometrical method the thermal ionization of lead from oxides was investigated. For the production of ions a combined ion source was used. The influence of the chemical composition and the structure of the oxide layer on the degree of ionization has been studied. The behavior of different oxide modifications concerning the thermal consistency of the glass layer, the degree of ionization, the ion emission, and the stability of the ion current was determined. On the basis of these investigations recommendations are given as to the practical application of the thermal ionization for the isotope analysis of small amounts of lead. (auth)

2719 IMPROVEMENTS IN OR RELATING TO THERMOELECTRIC DEVICES. Sturge, Derek William James (to United Kingdom Atomic Energy Authority). British Patent 1,131,145. Oct. 23, 1968. Filed May 18, 1966.

A thermocouple is designed with a sheath for operation in direct contact with graphite at high temperatures up to 2000°C. The sheath comprises a refractory oxide coated on the outside with two layers of hard and soft pyrolytic carbon to accomodate thermal expansion. The sheath is filled with an inert atmosphere such as carbon monoxide. For not so high temperatures, a metal sleeve may be slid over the sheath and bonded to the carbon coating. (D.L.C.)

2720 A SIMPLE METHOD FOR DETERMINING THE SENSITIVITY OF PHOTOMULTIPLIERS. Pakhomov, E. P. (Inst. of High Temperatures, Moscow). Prib. Tekh. Eksp., No. 4, 183(July-Aug. 1968). (In Russian).

The method proposed for obtaining the sensitivity of photomultiplier tubes is based on the relation of signal to derivative of signal vs light intensity. This relation is shown to be convenient for checking field luminosity characteristics of photomultipliers using standard light sources or collections of filters. (tr-auth)

2721 USE OF THE MAXIMUM LIKELIHOOD TECHNIQUE FOR FITTING COUNTING DISTRIBUTIONS. II. APPLICATION TO ANGULAR DISTRIBUTIONS. Orth, P. H. R.; Olivo, M. A. (Univ. of British Columbia, Vancouver). Nucl. Instrum. Methods, 65: 307-10(Nov. 15, 1968).

The rapidly converging iterative method is used to determine the parameters defining an angular distribution. The data were collected using two separate detecting configurations, and furthermore there was a small uncertainty in the origin of the angular scale. As a result two extra parameters were included in the fitting function, which contained as well the usual Legendre polynomial terms. The best estimates of the parameters, together with a discussion of the relevance of the approximate standard deviations as obtained from the error matrix are presented. (auth)

2722 DIGITAL WORD GENERATOR. Polychronakis, G.; Mantakas, Ch. (Democritus National Research Center, Athens). Nucl. Instrum. Methods, 65: 317-21(Nov. 15, 1968).

A system capable of producing digital words is described. Its principle of operation is based on a multistage current switch. Thus, the use of a single transistor for each word digit is achieved. The generator, through two independent outputs, supplies the digital word in the form of both pulse and level logic. The sequence of digits can be generated once or repetitively. (auth)

2723 DESIGN OF A TIME–AMPLITUDE CONVERTER OF HIGH RESOLUTION FOR MEASURING FAST DECAY TIME OF SCINTILLATORS. Du Chaffaut, F.; Charmet, P.; Trabaud, R. (Commissariat a l'Energie Atomique, Paris). Nucl. Instrum. Methods, 65: 285-92(Nov. 15, 1968). (In French).

A high resolution time-amplitude converter for measuring the fast decay time of scintillators is described. The system, measuring time intervals between the start of the scintillation induced by an ionizing particle and the detection of a single visible photon, is able to measure decay times as short as 0.6 ns. Its resolution time is 38 ± 5 ps. This system enabled us to obtain the curves of the decay time of the NE 102 plastic scintillator and of nitrogen excited by alpha particles of ^{210}Po. (auth)

2724 USE OF THE MAXIMUM LIKELIHOOD TECHNIQUE FOR FITTING COUNTING DISTRIBUTIONS. I. APPLICATION TO THE SUM OF TWO EXPONENTIALS WITH CONSTANT BACKGROUND. Orth, P. H. R.; Falk, W. R.; Jones, G. (Univ. of British Columbia, Vancouver). Nucl. Instrum. Methods, 65: 301-6(Nov. 15, 1968).

A rapidly converging, iterative method of curve fitting, based on maximum likelihood theory utilizing either Gaussian or Poisson statistics, is presented. The technique is illustrated by application to the sum of two exponentials with constant background. The relevance of the standard deviations obtained from the error matrix is investigated for this particular case. (auth)

2725 ANALOG ON-LINE COMPUTATION OF REACTIVITY. Kontos, J. (Democritus Nuclear Research Centre, Athens). Nucl. Instrum. Methods, 65: 338-40(Nov. 15, 1968).

A method for the analog on-line computation of reactivity is presented. This method is based on an essentially integrating system in contrast to known methods that use differentiating systems. A simulation procedure was used for the evaluation of the method and a reactor control problem was considered as an example of application of the system. The new method compared satisfactorily with the differentiating method and particularly in the reactor control application performed better. (auth)

2726 MEASUREMENT OF THE LIMIT OF SENSITIVITY OF HYDROGEN IN A BUBBLE CHAMBER AND CALIBRATION OF PRESSURE GAUGES. Horlitz, G. (Deutsches Elektronen-Synchrotron, Hamburg); Wolff, S.; Harigel, G. Nucl. Instrum. Methods, 65: 353-7(Nov. 15, 1968).

A new method of calibrating pressure gauges in bubble chambers under operating conditions is described. Starting with different static pressures p_s, greater than the vapor pressure p_v, the dynamic pressure in a bubble chamber is reduced to an arbitrary, fixed value p(b,T). At a given temperature T, the appearance of this pressure is indicated by a constant bubble density b. A plot of the signal U of a pressure transducer [corresponding to the pressure drop $p_s - p(b,T)$] against the static pressure p_s, gives a straight line for every single b = const. The slope of these lines is equal to the sensitivity of the gauge. The extrapolated experimental line intersects the axis U = 0 in the point $p_s = p(b,T)$, which is independent of the calibration factor of the transducer. In an 85 cm bubble chamber, p(b,T) has been measured in the temperature interval $24.5 < T < 28.0$°K with b = 0, which represents the limit of sensitivity in a p-T diagram for relativistic electrons. (auth)

2727 MAGNET SWEEP CONTROL CIRCUIT. Barton, George W. Jr.; Dupzyk, Ronald J. (to United States Atomic Energy Commission). U. S. Patent 3,405,326. Oct. 8, 1968.

A method for combining rate analog feedback signals with position analog feedback signals to form an improved composite feedback signal is described. A feedback control circuit to control the strength of the magnetic field which sweeps a mass spectrum of charged particles past an analyzer slit in a mass spectrometer is described. A Hall-effect differential gaussmeter and an induction coil gaussmeter are used. (W.H.K.)

2728 WIDE-BAND TIME-TO-AMPLITUDE CONVERTER. Budyashov, Yu. G.; Zinov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 4, 102-5 (July-Aug. 1968). (In Russian).

A simple time-to-amplitude converter for measurements from 20 μseconds to 30 nanoseconds. The converter has a resolution of 1.4 picosecond and possesses good temperature and transient stability. (tr-auth)

Radiation Effects on Instruments and Instrument Components

Refer also to abstracts 2482 and 3571.

2729 (HMI-B-70) INVESTIGATIONS OF THE ELECTRICAL PROPERTIES OF MNS-TRANSISTORS, PRODUCED IN THE U. S., UNDER INFLUENCE OF γ-IRRADIATION OF ^{60}Co (4000 Ci), NUCLEAR-REACTOR NEUTRONS (RESEARCH REACTOR BER), AND 1.5-MeV ELECTRONS. Wagemann, H. G.; Zander, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). (BEW-13). Dep.

Measurements of transconductance, capacitance and recombination currents of irradiated devices lead to the conclusions, that ionizing γ-irradiation shifts the turn-on voltage according to a buildup of positive space charge in the insulating layer and diminishes the transconductance. As a function of γ-irradiation flux and bias during irradiations the changes of these quantities tend to saturate. (auth)

2730 (HMI-B-71) INCREASE OF INTERNAL FIELD EMISSION CURRENT IN SILICON ZENER DIODES UNDER IRRADIATION WITH REACTOR NEUTRONS. Wagemann, H. G.; Zander, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Aug. 1968. 31p. (In German). (BEW-14). Dep.

Current-voltage-characteristics of silicon zener diodes of different zener voltages are analyzed for different states of irradiation (neutrons of BER reactor) by means of their temperature coefficient $c : c < 0$ leads to the conclusion of prevailing internal field emission. A simple model attributes the increase of leakage current for constant reverse voltage to the density of neutron induced displacements within the energy gap, which allow an additional current due to internal field emission. This model is examined by evaluating the decreasing minority carrier lifetime, the reciprocal value of which behaves in a similar way as the increasing leakage current. The minority carrier radiation damage constants k are calculated, their average amount is $k = 2 \cdot 10^{-5}$ s^{-1} cm^2. (auth)

2731 (HMI-B-72) INVESTIGATIONS OF THE CHANGE OF THE ELECTRICAL PROPERTIES OF CERAMIC THICK FILM CIRCUITS (SCREEN PRINTED) UNDER THE INFLUENCE OF 1.5-MeV ELECTRON AND γ IRRADIATION (^{60}Co, 4000 Ci). Wagemann, H. G. (Hahm-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Aug. 1968. 35p. (In German). (BEW-15). Dep.

Five different types of ceramic thick film circuits (screen printed) of industrial origin were irradiated, gradually up to doses of 10^{16} cm^{-2} 1.5 MeV-electrons and 10^8R ^{60}Co γ-rays. Resistors, capacitors (produced in different techniques), diodes, and transistors were investigated concerning their irradiation resistivity. Resistors showed a threshold dose for decreasing ohmic resistance. Capacitors and diodes proved very stable regarding irradiation experiments. Transistors showed a well understood course of damage. (auth)

2732 (N-68-26603) STUDY OF CHARGE STORAGE IN SILICON OXIDE RESULTING FROM NON-PENETRATING ELECTRON IRRADIATION. Simons, M.; Monteith, L. K.; Hauser, J. R. (Research Triangle Inst., Durham, N. C.). June 1968. Contract NAS1-6900. 78p. (NASA-CR-1088). CFSTI.

Charge storage in silicon dioxide resulting from low energy electron irradiation has been observed. The positive charge build-up has been studied in MOS type structures for various oxide thicknesses as a function of beam energy, electron fluence, sample bias, electrode thickness, and a number of oxide-related parameters. The effective radiation-induced oxide charge appears to be a function of beam energy dissipated within the oxide near the oxide–silicon interface; this charge increases with electron fluence up to a saturation level which was observed in some steam-grown oxides; the experimentally observed dependence of induced charge on applied bias is compared with that predicted by several models for charge accumulation. Optical and thermal annealing of the trapped charge has been studied in an effort to derive information on the nature of the oxide trapping levels. Reduction of trapped charge by irradiation at small negative biases has also been explored. Finally the development of a two-carrier model for space charge build-up in an MOS structure is discussed and the experimental results obtained for silicon dioxide are related to device performance in the radiation environment. (auth) (STAR)

2733 THEORY OF THERMAL BREAKDOWN OF ELECTRICAL INSULATION UNDER THE ACTION OF RADIOACTIVE RADIATION. Bogoroditskii, N. P.; Volokobinskii, Yu. M. (Leningrad Electrotechnical Inst.). Zh. Tekh. Fiz., 37: 1514-18 (Aug. 1967). (In Russian).

The proper utilization of radiotechnical equipment in the radiation fields of nuclear reactors and the problem of the direct transformation of nuclear radiation energy into electrical energy require a knowledge of the intensity of thermal breakdown of electric insulation subjected to intensive fluxes of penetrating radiation. In calculating the intensity of thermal breakdown of insulation in the field of radioactive radiation, two facts are taken into consideration: the absorption of nuclear radiation energy causes an additional heating of the electrical insulation, and dimensions, forms, and material of the irradiated article. Because of both the ionization and nuclear reactions occurring as the result of radiation, the dielectric constant ε and the tangent of the angle of dielectric losses tgδ, can change. (B.G.D.)

2734 THE EFFECT OF TRANSIENT IONIZING RADIATION UPON SCHOTTKY BARRIER DIODES. Schnurr, Robert Harold. Albuquerque, N. Mex., Univ. of New Mexico, 1968. 120p. Thesis.

The theory of operation of the Schottky barrier diode was reviewed. The complications caused by a more accurate space charge formulation were discussed. Consideration of image effects, tunneling, interfacial dielectric layers, surface states, and minority carrier current was also included. The interaction of ionizing radiation with semiconducting materials was reviewed. The behavior of a Schottky barrier diode in an ionizing radiation environment was considered. The resultant model for the Schottky barrier diode is analogous to a p-n diode with one side having a very high dopant concentration. Tests were performed upon GaAs and silicon Schottky barrier diodes, using a 2 MeV flash X-ray machine. The GaAs Schottky barrier diodes were tested while functioning as an X-band detector and mixer. No permanent change was observed in the voltage–current characteristic, capacitance–voltage characteristic, or noise figure of the diodes after irradiation. Diodes fabricated from both types of materials were also tested in a more conventional dc bias circuit. Both types of diode were exposed to a mixed neutron–gamma pulse at the Sandia Pulsed Reactor II. Neutron fluences up to 5×10^{14} nvt and gamma dose rates up to 10^9 R/sec were obtained. The diodes showed very minor changes in voltage–current characteristics for a total neutron fluence up to 1.2×10^{15} nvt. (Disser. Abstr.)

2735 INVESTIGATION ON THE INFLUENCE OF NEUTRON IRRADIATION ON THE THERMOELECTRIC PROPERTIES OF DOPED Ge–Si ALLOYS. Hesse, J. (Allgemeine Elektrizitaetsgesellschaft, Frankfurt am Main). Z. Angew. Phys., 25: 331-5 (Nov.-Dec. 1968). (In German).

The effect of neutron-irradiation on the thermoelectric properties of highly doped Ge–Si and thermocouples made of this material have been examined. It was found that integrated fluxes of up to 5×10^{18} neutrons/cm^2 do not affect the room temperature values of Seebeck coefficient, of thermal and electrical conductivities. The mechanical properties are also not changed by this flux. (auth)

2736 PHOTOCONDUCTION IN CdS CRYSTALS GENERATED BY A MODULATED ELECTRON BEAM. Stoessel, W.; Zimmermann, W. (Univ., Karlsruhe, Ger.). Phys. Status Solidi, 30: 311-18 (Nov. 1, 1968).

A modulated photocurrent in CdS crystals is obtained by irradiation with an intensity-modulated electron beam. The experimental setup for the irradiation is described. From the frequency dependence of the ac photocurrent a relaxation time τ_R is defined; τ_R decreases with increasing irradiation intensity B. At complete filling of the traps, it reaches the value of the free electron lifetime τ. From the dependence $\tau_R(B)$ the approximate depth and the concentration of the traps, which are involved in the relaxation processes, are determined to $E_c - E_H = 0.215$ eV and $H = 8.5 \times 10^{14}$ cm^{-3}. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 2564, 2582, 2826, 2827, 2831, 2850, 2851, 2883, 2884, 2901, 2919, 2934, 2937, 2940, 2941, 2947, 2952, 2955, 2979, 2991, 3006, and 4485.

2737 (AEC-tr-6871/1) UKRAINIAN JOURNAL OF BIOCHEMISTRY. Translation of Ukr. Biokhim. Zh., 39: 3-105 (1967). 122p. (TT-68-50323/1; IPST-Cat.-5117). CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2738 (CALT-642-8) GENETIC ASPECTS OF THE IMMUNE RESPONSE. Owen, Ray D. (California Inst. of Tech., Pasadena). [1968]. 32p. (CONF-680711-1). Dep. CFSTI.

From 11th Conference on Blood Groups and Protein Polymorphism in Animals, Warsaw, Poland.

The state of knowledge and the significance of genetic control of immunoglobulin molecular variation are briefly summarized. The structure and control of synthesis of immunoglobulin molecules is outlined against a background of understanding of the structure and control of synthesis of hemoglobin. (B.S.L.)

2739 (CALT-642-X-9) STUDIES IN DEVELOPMENTAL IMMUNOGENETICS. 3-Year Comprehensive Report. (California Inst. of Tech., Pasadena). [1968]. 10p. Dep. CFSTI.

Main research accomplishments of the past three years, with special reference to the originally stated objectives are briefly discussed. The effects of radiation on primary and secondary antibody responses in the elasmobranchs and characterization of normal human blood-group antibodies are very briefly reported. The more sustaining and substantial works that dealt with developmental change in red-cell antigenicity in the fowl; the lymphocytosis-promoting factor associated with transplantable lymphomas in mice; the nature of a serological system (antibodies and complement) that stabilized rather than inactivated T2H bacteriophages; and comparative studies of immunoglobulins and the polypeptide chains that constitute them are discussed in detail. (B.S.L.)

2740 (COO-78-174) ANNUAL REPORT FOR PERIOD ENDING APRIL 30, 1968. Friedell, Hymer L. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology). May 1, 1968. Contract W-31-109-eng-78. 179p. Dep. CFSTI.

The results and status of research in the Department of Radiology at Case-Western Reserve University are reported. For convenience, the reports are submitted in the following sections: radiation physics, radiation cytology, radiation biochemistry, radiation modifiers, and radiation physiology. A list of publications and reports originating in the department is included as well as a list of the meetings attended and papers presented. (E.R.B.)

2741 (COO-1339-22) ANIMAL METABOLIC STUDIES OF STRONTIUM AND CALCIUM WITH SPECIFIC REFERENCE TO FALLOUT RADIONUCLIDES. Progress Report No. 5, August 16, 1967-August 15, 1968. (Illinois Univ., Urbana). Contract AT(11-1)-1339. 28p. Dep. CFSTI.

Experimental work was carried out on kinetics of ^{47}Ca metabolism in goats and cows; retention of ^{85}Sr in pigs as a function of age, dietary calcium and phosphorus levels, and breed; hydroxyproline excretion in swine as a function of age; hypophysectomy of swine with ^{90}Y; effect of exercise on mineral and organic bone turnover in swine; effect of sodium alginate, barium sulfate, and sodium sulfate on the gastrointestinal absorption of ^{85}Sr in swine; and effects of time on distribution of injected ^{85}Sr in six-month-old swine. Results of the two major areas of investigation, kinetic studies of calcium metabolism in goats and cows and retention of Sr in pigs, are considered in more detail than in the other five areas. Summaries of all studies are presented. (B.S.L.)

2742 (COO-1596-2) THE ECOPHYSIOLOGY OF CORN: FLORAL MORPHOGENESIS AND MINERAL ION TRANSPORT. Final Report. Sudia, Theodore W. (Minnesota Univ., St. Paul. Dept. of Agronomy and Plant Genetics). Sept. 30, 1968. Contract AT(11-1)-1596. 17p. Dep. CFSTI.

Strontium-85, ^{65}Zn, and ^{134}Cs were applied to the leaves of corn plants at weekly intervals and samples were taken after 24 hrs and at maturity. Only small amounts of the isotopes were taken up by the plants. In other experiments silks were immersed in solutions of ^{133}Ba, ^{134}Cs, and ^{65}Zn; translocation of minerals out of the silks did not occur. Another series of experiments was conducted in which solutions of ^{133}Ba and ^{134}Cs were applied to leaves of 600 plants. At harvest the different parts of the plants were analyzed separately for radioactivity. The tabulated data show that ^{134}Cs was distributed generally throughout the plant; the concentration of isotope after 24 hrs was greatest in those tissues nearest the spot of application. Very little ^{133}Ba was absorbed by the plants. The concentration of ^{134}Cs in the stem was always higher than that in the ear. The concentration of ^{134}Cs in the ear was greatest when the treated leaf was attached to the node immediately above and opposite the point of attachment of the ear. (H.L.W.)

2743 (ORO-3489-5) THE EFFECTS OF RADIATION AND IMMUNOSUPPRESSIVE DRUGS ON ANTIBODY FORMATION AND ALLERGY. Progress Report, December 1, 1967-August 31, 1968. Jennings, B. R. (Tennessee Univ., Memphis). Aug. 30, 1968. Contract AT(40-1)-3489. 16p. Dep. CFSTI.

The character of the immunosuppressive effects of actinomycin D and x radiation when administered around the time of primary antigenic stimulus with tetanus toxoid was studied. Exposure to the immunosuppressants was 1 or 2 days before or 0 to 1 day after antigenic stimulus +2 (after). Actinomycin D or x radiation was noted to produce an augmented primary antigenic stimulus. This augmented response was not evident when both of the immunosuppressants were given. The fluorescent antibody technique was valid for use in enumeration of antibody producing spleenocytes. Also, an attempt was made to modify the Jerne Plaque technique so that the number of cells forming tetanus antitoxin could be quantitated; results are discussed. (B.S.L.)

2744 (ORO-3596-6) PROGRESS REPORT, AUGUST 1, 1967-JULY 31, 1968. Billen, Daniel (Florida Univ., Gainesville. Radiation Biology Lab.). Aug. 1, 1968. Contract AT(40-1)-3596. 9p. Dep. CFSTI.

A list of the publications of work on the effects of radiation on DNA and DNA replication and correlation of lethality and DNA damage in x-irradiated cells is given. Brief summaries of each paper are presented. (B.S.L.)

2745 (ORO-3599-4) VISUAL CELLULAR STIMULATION BY HIGH ENERGY QUANTA. Technical Progress Report, December 1, 1967-September 1, 1968. Dawson, William W. (Florida Univ., Gainesville. Coll. of Medicine). Aug. 19, 1968. Contract AT(40-1)-3599. 26p. Dep. CFSTI.

The responsiveness of visual system to ionizing radiations was studied. The popular hypothesis that x rays stimulate the visual system by interacting directly with the photo chemical or indirectly through entoptic production of fluoresence was tested. The results were clear-cut and were described in a previous report. Analyses of the statistics were highly significant indicating that the hypotheses stated above should be rejected. That is, two alternative hypotheses may be generated: X-ray excitation of rhodopsin-bearing visual structures was by direct interaction with the nervous system or indirect interaction with neural structures through the production of free radicals. Ionizing rays or free radicals produced by them had slight effects upon photopigment concentration but these effects were secondary to physiological excitation produced at places other than the photopigment in receptive structures. Further, measurement of visual function indicated no pathology of a receptive nature where x-ray doses in the 12,000 R range were delivered. This suggested that mammalian eye x-ray pathology is dependent upon cellular metabolism rather than upon photochemical and neurological membrane or chemical structures. This assumes that current theory is correct for similarities in neutral membrane structure and photopigments between vertebrate and invertebrate species. (auth)

2746 (RT/BIO-(68)5) RESEARCH ON THE DIFFERENTIATION OF IMMUNOLOGICALLY SUITABLE CELLS IN IRRADIATED ANIMALS. Final Report, 1963-1965. Doria, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Nov. 23, 1966. Contract 021-63-3 BIOI. 26p. (In Italian). (EUR-3261). Dep.

The differentiation of immunologically suitable cells in irradiated rats treated with hemopoietic tissue was studied. The role of the irradiated thymus in the adoptive immunity was determined. The importance of the thymus was shown by the following observations. Adult animals, thymectomized at birth, had scarcely developed lymphatic tissue and were incapable of producing antibodies with the normal vigor. The spontaneous recovery of the immunity system of adult animals exposed to sublethal x-ray doses depended on the presence of the thymus. (J.S.R.)

2747 (UCRL-Trans-10211) AUTORADIOGRAPHIC INVESTIGATION OF DIURNAL FLUCTUATIONS IN THE ^{3}H-INDEX AND THE MITOTIC INDEX IN CELL TYPES OF ADULT MICE, RAT FETUSES, AND ASCITES TUMOR CELLS. Pilgrim, Ch.; Lennartz, K. J.; Wegener, K.; Hollweg, S.; Maurer, W. Translated by F. S. Freisinger for Univ. of California, Lawrence Radiation Lab., Livermore, from Z. Zellforsch. Mikroskop. Anat., 68: 138-54(1965). 39p. Dep. CFSTI. JCL $3.60 fs, $1.37 mf.

Diurnal fluctuations in the uptake of injected tritium, used as a label for thymidine, and the mitotic index were investigated in 10 different cell types of normal mice, in five fetal cell types (rats, 20th day of pregnancy) and in three ascites tumors. The animals were sacrificed 40 minutes after injection of ^{3}H-thymidine. Autoradiographs were prepared from various organs. Diurnal fluctuations of DNA synthesis, as indicated by the uptake of tritium-labeled-thymidine, were observed in a number of cell types of the adult animal, aside from the diurnal fluctuations of the mitotic index. These ^{3}H-index fluctuations were found without exception in all cell types in which diurnal fluctuations of the mitotic index were observed. In other tissues, diurnal fluctuations could not be demonstrated with both indices. Diurnal fluctuations of the ^{3}H- and the mitotic indices were also absent in the fetal cells and in the ascites tumors. The diurnal fluctuations of the ^{3}H-index are regarded as partial synchronizations of cells that occur at a certain time of day. The daily course of the rate of entry of cells into S-phase was calculated from the ^{3}H-index curves. (auth)

2748 THE TRANSPORT OF PLUTONIUM, AMERICIUM, AND CURIUM IN THE BLOOD OF RATS. Turner, G. A.; Taylor, D. M. (Inst. of Cancer Research, Sutton, Eng.). Phys. Med. Biol., 13: 535-46(Oct. 1968).

The rates of disappearance of plutonium, americium and curium from the blood after intravenous injection in various chemical forms was studied in rats. The rate of removal of plutonium was markedly influenced by the physicochemical form of the injected plutonium and especially by the presence of colloidal material. The plasma clearance rate of plutonium injected as a citrate solution which had been freed from polymeric species, by filtration through a 10 mμ pore diameter filter, is considered to afford a close approximation to the rate of disappearance of plutonium which enters the blood in soluble form from the lung, gastrointestinal tract, or through a contaminated wound. In contrast to plutonium, the plasma clearance rates of americium and curium are more rapid and much less influenced by chemical form. A study of the distribution of plutonium, americium and curium among the serum proteins at various times after injection showed that plutonium was always found mainly in the β_1 globulins, but that americium and curium were more generally distributed between the various serum proteins. All the results provide further evidence of the differences between tetravalent plutonium and the trivalent actinides in their reactions with biological systems. (auth) (UK)

2749 CONCENTRATION OF SODIUM, POTASSIUM, CALCIUM, AND BICARBONATE IONS IN SERUM SAMPLES FROM PATIENTS TREATED WITH X RAYS FOR UTERINE CERVICAL CANCER. Wawrzkiewicz, Marian (1st Obstetrics and Gynecology Clinic, Wroclaw). Ginekol. Pol., 37: 83-7(Jan. 1966). (In Polish).

After preliminary treatment for circulatory ailments, high-blood pressure, and/or kidney diseases, each of the 15 gynecologic patients, aged 31 to 51 yr, received 8400-mg-hr Ra implantation, and then histopathologic and clinical examinations of uterine cervix were made. They revealed the presence of invasive planoepithelial carcinoma in the 1st and 2nd stages. The initial examination of patients was performed 24 hr prior to the beginning of subsequent x irradiation treatment. Later examinations followed 6000- and 12,000 R doses. Concentrations of Na and K ions were determined in blood and in daily urine specimens, and the concentration of Ca in blood specimens only. It was found that while the blood Na level prior to irradiation was 142.7 meq/l, after a dose of 6000 R it decreased to 141.7 meq/l, and then increased to 143.5 meq/l after a dose of 12,000 R. The initial concentration of K was 4.76 meq/l; then it decreased to 4.64 meq/l after 6000 R and to 4.75 meq/l after the 12,000 R dose. The initial level of Ca was 5.02 meq/l, which decreased to 4.86 meq/l after 6000 R and to 4.81 meq/l after 12,000 R. The initial level of bicarbonate ion was 23.68 meq/l; it increased to 24.12 meq/l after 6000 R and decreased to 23.16 meq/l after 12,000 R. The 12,000 R x radiation dose apparently had no deleterious effect on kidneys. Statistically significant increases of the Na and K renal clearances were noted after 6000 R. (BBB)

2750 HUMAN RENAL HOMOTRANSPLANTATION. Denis, L. J. (Hopital Militaire, Anvers, Belg.). Acta Urol. Belg., 34: 101-226(Apr. 1966). (In French).

Use of ionizing radiation and other immunosuppressive agents to achieve immunological tolerance was discussed. Renal homotransplantation was considered from biological and technical aspects. Postoperative therapy included local irradiation. Irradiation suppressed the cellular infiltration of the grafted kidney. In a number of clinical cases irradiation was used to treat incipient rejection. Preventive local irradiation was used, although in one experiment on dogs, no significant prolongation of functional survival of the transplanted kidney occurred after local irradiation of 100 RAD per day. In another series of animal experiments, a local fraction irradiation dose of 150 RAD produced significant functional survival in homologous renal transplants. This dose, applied the first, third, fifth, and seventh days was recommended for clinical usage. The theoretical advantage of local irradiation lay in the destruction of lymphocytes producing antibodies in the transplant and of cells that transported the antigens from the kidney. Supplementary irradiation was given to treat the impending rejection with a dose no larger than 900 RAD which gave a sufficient margin of safety against radiation nephritis (at a maximum dose of 1500 RAD). It was concluded that from a statistical point of view successful grafts occurred both with and without irradiation. (BBB)

2751 RADIOISOTOPE ACCUMULATION IN VASCULAR WOUNDS AS A MEASURE OF ARTERIAL REPAIR. Strain, William H.; Pories, Walter J.; Peer, Richard M.; Childers, Richard C.; Worland, Richard L.; Zaresky, Stephen A.; Rob, Charles G. (Univ. of Rochester, N. Y.). Trans. Amer. Nucl. Soc., 11: 475-6(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2752 INFLUENCE OF AGE AND SEX ON ABSORPTION AND RETENTION OF RADIOISOTOPES. Strain, William H.; Pories, Walter J.; Dattilo, Elaine; Peer, Richard M.; Zaresky, Stephen A. (Univ. of Rochester, N. Y.). Trans. Amer. Nucl. Soc., 11: 476-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2753 ACTIVATION ANALYSIS OF A HUMAN ABDOMINAL ANEURYSM. Strain, William H. (Univ. of Rochester, N. Y.); Rob, Charles G.; Pories, Walter J.; Terry, Roger A.; Childers, Richard C.; Hennessen, John A.; Thompson, Maxwell F. Jr.; Graber, Francis M. Trans. Amer. Nucl. Soc., 11: 477-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

2754 ACTIVATION ANALYSIS OF SERUM VITAMIN B_{12}. Jansen, Carl; Leddicotte, George; Navarrette, Manuel (Univ. of Missouri, Columbia). Radiology, 91: 813(Oct. 1968).

A method is described for the estimation of the content of vitamin B_{12} in blood serum by neutron activation using the reaction $^{59}Co(n,\gamma)^{60m}Co$. Vitamin B_{12} has a cobalt atom and cobalt is not found elsewhere in the serum, so the amount of ^{60}Co is proportional to the amount of vitamin B_{12}. (C.H.)

2755 DETERMINATION OF DEUTERIUM OXIDE IN TISSUE BY MEANS OF INFRA-RED SPECTRA. Kuksina, V. N.; Lobina, I. G. (Tomsk Medical Inst., USSR). Lab. Delo, No. 5, 303-4 (1967). (In Russian).

The spectra were recorded with an IKS-14 instrument (LiF prism); absorption maximum for H_2O and ^2H_2O occurred at 3360 and 2475 cm^{-1}, respectively. The infrared spectra of serum, heart tissue and ovary-tissue fluid of white mice injected with ^2H_2O were studied, and the results are discussed. (Anal. Abstr.)

2756 PLASMA DEOXYCYTIDINE: INCREASED LEVELS AFTER X-IRRADIATION. Guri, C. D.; Swingle, K. F.; Cole, L. J. (Naval Radiological Defense Lab., San Francisco). Proc. Soc. Exp. Biol. Med., 129: 31-4(Oct. 1968).

The demonstration of dose-dependent increase in plasma deoxycytidine (CdR) in rats after their exposure to relatively low doses of x rays, suggested that the quantitative determination of this compound as early as four hr postirradiation might be of value as a biologic dosimeter or indicator of radiation injury at sublethal doses. Significant elevations in plasma deoxycytidine levels were detected at x ray doses as low as 25 or 50 R, with a positive dose-response relationship evident at doses up to 100 R. The rapid sampling possible with blood plasma, as well as the absence of significant interference by other uv absorbing substances suggested that determination of levels of CdR and of other pyrimidines in man after therapeutic irradiation would be feasible and useful. (auth)

2757 HEMOPOIETIC PROGENITOR CELLS OF THE MOUSE INCAPABLE OF SELF-REPLICATION. Bennett, Michael;

Cudkowicz, Gustavo (Roswell Park Memorial Inst., Buffalo). Proc. Soc. Exp. Biol. Med., 129: 99-104(Oct. 1968).

Small numbers of transplanted marrow cells generated both differentiating hemic cell progeny and new undifferentiated progenitor cells. Comparable grafts of spleen cells generated only the former. Thus, hemopoietic progenitor cells consisted of at least two compartments: precursor cells which did not self-replicate and their more primitive precursors called stem cells. The pool size of stem cells relative to that of precursor cells was much greater in bone marrow than in spleen of adult mice. (auth)

2758 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF SELENIUM IN BIOLOGICAL SAMPLES. Veveris, O. E.; Mikhel'son, G. G.; Pelekis, Z. E.; Pelekis, L. L.; Taure, I. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 4, 13-16(1968). (In Russian).

A method was developed for determining selenium in biological tissues using ^{77m}Se with a half life of 17.5 sec. The specimens were dried in a vacuum at +50°C and irradiated by neutron flux in a IRT-2000 reactor. The sensitivity of selenium was 0.05 μg/g. (tr-auth)

2759 STATE AND MORPHOLOGICAL CHARACTERISTICS OF THE ADRENAL CORTEX IN RATS IN CARCINOGENESIS INDUCED BY A MINIMUM DOSE OF ^{90}Sr. Berezovskii, B. S. (Veterinary Inst., Kazan). Vop. Onkol., 14: No. 8, 77-81(1968). (In Russian).

In the first series of experiments (85 rats) at various terms after injection of 0.05 μc/g of ^{90}Sr the animals were sacrificed and weight of the adrenal gland and width of zones were determined. In the second series of experiments under the same conditions antitumor resistance was determined by means of the fractional transplantation of Seidel hepatoma. The initial period (12 to 16 weeks) after strontium injection was characterized by intensive hormonopoiesis and definite resistance to tumor. The second period was characterized by reduced hormonopoiesis and decreased antitumor resistance. (auth)

2760 ON THE UPTAKE OF ^{65}Zn AND THE CONCENTRATION FACTOR ON Zn IN MARINE ORGANISMS. I. UPTAKE OF ^{65}Zn IN MARINE ORGANISMS. Kameda, Kazuhisa (Japan Atomic Research Inst., Ibaraki); Shimizu, Makoto; Hiyama, Yoshio. J. Radiat. Res., 9: 50-62(June 1968).

In order to know the concentration factor of Zn in marine organisms, shellfish, echinoderm and fish were kept in sea water containing ^{65}Zn and the uptake of radioactivity by organisms was traced. Two series of experiments were carried out. In the experiment A, the distribution of the nuclide and concentration factor in each organ and tissue were observed. In the experiment B, the influence of Zn content in sea water on the uptake of radioactive Zn was checked by means of the whole body counting. Zn determination was made on the muscle of Tapes japonica to obtain the concentration factor which was compared with that obtained by tracer experiment. The concentration factors of Zn are different in different organisms as well as in different tissues and the following figures were obtained; 3 to 20 for fish, 50 to 400 for shellfish and 15 to 500 for sea urchin. However, as the equilibrium was not reached in many of organs and tissues within 42 days of experimental period, higher values should be considered as the concentration factor at the equilibrium condition. The concentration factor for the muscle of T. japonica was observed to be 5,600 by chemical analysis and 50 by tracer experiment. The cause of this big discrepancy is yet unknown but may be partly owing to the fact that Zn content of sea water changed greatly during the rearing experiment. (auth)

2761 NONSPECIFIC DELAYED REJECTION OF ALLOGENIC SKIN IN IRRADIATED MICE PROTECTED WITH IMMATURE HEMATOPOIETIC TISSUE. Rogers, Waid (Univ. of Texas, San Antonio); Aust, J. Bradley. Angiology, 19: 372-80 (June 1968).

Various strains of mice (A, C3H(Z)), (A X C3H(Z))F_1, C57BL, BALB/c, and D2b), lethally x irradiated (1000 R), were protected with intravenous suspensions of fetal or newborn liver or adult spleen. Mortality and the graft-vs-host reaction were greatest when allogenic adult spleen was used. A significant decrease in mortality and graft-vs-host reaction was observed if allogenic newborn or fetal liver was substituted in the same strain combinations. Use of isogenic tissue or protection of parental animals with F_1 hybrid adult or immature tissue resulted in the lowest mortality with no graft-vs-host reaction. The advantages of the fetal or newborn liver over adult spleen were presumably due to the immunologic immaturity of the former. Specific tolerance across H2 histocompatibility barriers was achieved in lethally (1000 R) x irradiated adult mice protected with allogenic adult spleen and newborn or fetal liver suspensions. The F_1 hybrid system was superior in achieving tolerance in the parental animal to tissue of the opposite parental type across wide immunologic barriers without the graft-vs-host reaction. Adult mice protected from lethal irradiation with isogenic or allogenic fetal or newborn liver showed a prolonged unresponsive period to allografts foreign to both host and hematopoietic tissue donor. Evidently, immunologically immature donor cells were able to acquire tolerance to both the host and third strain graft antigens. (BBB)

2762 ELECTROPHORETIC BEHAVIOR OF CELLULAR SOLUBLE PROTEINS IN THE KIDNEY OF NORMAL AND IRRADIATED RATS. Slaviero, G. E.; Pallavicini, E. Bobbio; Zampaglione, G. (Univ., Pavia, Italy). Minerva Radiol., 13: 287-91(May 1968). (In Italian).

The behavior of cellular soluble proteins of the kidney of normal rats submitted to x irradiation at a single lethal dose or with refracted doses for variable periods was studied. As regards the cellular soluble proteins in the irradiated animals, there was a slight reduction in proteins migrating to albumin and in those migrating to γ globulin whereas there was a percentage increase in the other fractions. The phenomenon appeared particularly evident in the kidneys of rats treated with the most intense doses or killed at a longer time after irradiation with the single lethal dose. The results are commented on in brief. (auth)

2763 DEOXYRIBONUCLEIC ACID CONTENT ASSOCIATED WITH NUCLEAR CHANGES IN ^{131}I-IRRADIATED HUMAN THYROIDS. Dobyns, Brown M.; Robison III, Leon R. (Western Reserve Univ., Cleveland. Metropolitan General Hospital, Cleveland). Contract AT(30-1)-1243. J. Clin. Endocrinol. Metab., 28: 875-85(June 1968).

Samples of tissue from human thyroids previously treated with ^{131}I for hyperthyroidism and subsequently studied extensively for early and late radiation effects were used for a morphologic study. A microspectrophotometric method was used to measure the amount of DNA in individual nuclei. Doses of ^{131}I just sufficient to bring hyperthyroidism slowly under control but not to produce significant architectural derangement result in increased nuclear DNA and variations in amounts of DNA and nuclear volume. Such changes correspond to the occasional bizarre nuclear forms previously recognized in such thyroids. The amounts of DNA in individual nuclei are sometimes found to surpass two times the diploid value, the level at which division of the cell should occur. Evidence suggests that this is thwarted cell division and probably explains the ultimate failure of thyroid function years after a euthyroid state was achieved by ^{131}I therapy. Thyroid tissue from non-irradiated patients and from others who received x radiation to the cervical area were included in the study for comparison. (auth)

2764 SOME EFFECTS OF URANYL ACETATE ON PROXIMAL TUBULAR FUNCTION IN RABBIT KIDNEY. Nomiyama, Kazuo; Foulkes, E. C. (Univ. of Cincinnati). Contract AT(11-1)-1991. Toxicol. Appl. Pharmacol., 13: 89-98(July 1968).

Acute renal failure was studied in rabbits two days after the intravenous injection of uranyl acetate (0.2 mg uranium per kilogram body weight). The poisoned animals showed a decreased inulin clearance and even greater inhibition of mannitol and creatinine clearances. This finding implicates back-diffusion of tubular contents as a factor possibly contributing to the observed depression of glomerular filtration rate. Tubular function as measured by Tm_G and Tm_{PAH} showed even more complete inhibition than glomerular function, indicating a cytotoxic effect on the renal tubule. Analysis of transport kinetics in tissues from poisoned animals in vitro permitted the localization of the major lesion in the PAH secreting system at the peritubular membrane. Efflux of PAH from cells into tubular lumen appeared unaffected. In agreement with the reduced PAH transport into cells, yet unchanged efflux from cells, the intracellular accumulation of PAH in vivo was grossly inhibited. Some implications of these findings for the mechanism of attack of uranium on the renal tubule are discussed. (auth)

2765 FORMATION OF THE THYMINE RADICAL IN IRRADIATED DNA. Lenherr, A. D.; Ormerod, M. G. (Royal Military Coll. of Science, Swindon, Eng.). Biochim. Biophys. Acta, 166: 298-310(Sept. 24, 1968).

ESR spectroscopy was used to study free radical formation and reactions in frozen aqueous solutions of DNA, thymidine and thymidylic acid, γ-irradiated at 77°K. ESR spectra were recorded at 77°K immediately after irradiation and after warming to higher temperatures. The effect of added cystamine was also investigated. Our results suggest that the paramagnetic species stabilized on DNA and the thymine compounds at 77°K are anions. The well known thymine radical appeared either after warming the samples to 195°K or after post γ-irradiation with ultraviolet light. Added cystamine reduced the thymine radical concentrations.

Our results are consistent with the postulate that the thymine radical in irradiated DNA is not formed by the direct addition of a hydrogen atom to the thymine ring but is formed by proton transfer to the thymine anion. (auth)

2766 TECHNIQUES FOR DNA HYBRIDIZATION IN VITRO USING NON-RADIOACTIVE DNA AND DNA MADE RADIOACTIVE BY NEUTRON ACTIVATION, ALKYLATION WITH RADIOACTIVE ALKYLATING AGENTS, AND BY EXCHANGE WITH ^3H_2O. Searcy, Dennis G. (Univ. of California, Los Angeles). Biochim. Biophys. Acta, 166: 360-70(Sept. 24, 1968).

The object of this study was to develop methods for detecting DNA–DNA hybrids in vitro when radioactive DNA could not be easily prepared by biosynthesis from radioactive precursors. DNA made radioactive by exchange with ^3H_2O at 90° for 48 h showed high specificity in hybridization in vitro at 60° and had a high specific activity which did not readily exchange off the DNA during the hybridization procedure. DNA made radioactive by neutron activation in a nuclear reactor reacted with high specificity in hybridization in vitro, but the specific activity was low. DNA made radioactive by alkylation with [^{3}H] dimethyl sulfate or [^{3}H] ethyl iodide rapidly lost the radioactive label from the DNA polymer under the conditions of hybridization in vitro. Alkylated DNA stabilized by treatment at high pH reacted with little specificity in hybridization in vitro. Chemically detecting hybridization in vitro of non-radioactive DNA fragments did not give good quantitative data. The background was very high due to the immobilized DNA leaching off the nitrocellulose filters. (auth)

2767 REACTIONS OF ISOTOPIC OXYGEN EXCHANGE IN ENZYMIC SYSTEMS INVOLVED WITH THE ACCUMULATION AND EXPENDITURE OF ATP ENERGY. Panteleeva, N. S. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Biol., No. 4, 565-74(July-Aug. 1968). (In Russian).

A review is presented of the use of ^{18}O for studies on molecular mechanisms of enzyme reactions during oxidative phosphorylation and ATP hydrolysis. Fifty-three papers are reviewed. (auth)

2768 ONE-ELECTRON REACTIONS IN BIOCHEMICAL SYSTEMS AS STUDIED BY PULSE RADIOLYSIS. I. NICOTINAMIDE–ADENINE DINUCLEOTIDE AND RELATED COMPOUNDS. Land, E. J.; Swallow, A. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Biochim. Biophys. Acta, 162: 327-37 (Oct. 1, 1968).

Some univalent oxidations and reductions of NAD and related compounds were studied by means of pulse radiolysis. Both hydrated electrons and the COO^- radical reduced NAD^+ with rate constants of $k = 2.5 \cdot 10^{10}\ M^{-1} \cdot sec^{-1}$ and $1.6 \cdot 10^9\ M^{-1} \cdot sec^{-1}$, respectively. The reduction led to a single free radical whose unpaired electron was located at the nicotinamide end of the molecule. By using AMP it was shown that the addition of an electron to the adenine group was followed by efficient electron transfer to the nicotinamide group. The absorption spectra of the free radicals formed from NAD and 1-methylnicotinamide chloride were determined, and shown to resemble published absorption spectra of related free radicals. The NAD (or 1-methylnicotinamide chloride) free radicals were shown to react with each other with a rate constant of $k = 5.6 \cdot 10^7\ M^{-1} \cdot sec^{-1}$ ($k = 6.9 \cdot 10^7\ M^{-1} \cdot sec^{-1}$ for 1-methylnicotinamide chloride), probably to give a dimer, as in previous experiments using x-irradiation. (auth)

2769 THE DISTRIBUTION OF THIAMINE-^{14}C IN THE RAT. Hayes, Donald Harvey. Baton Rouge, La., Louisiana State Univ. Baton Rouge, La., Agricultural and Mechanical Coll., 1968. 41p. Thesis.

The fate of a tracer dose of thiamine chloride (thiazole-2-^{14}C) hydrochloride was studied in young, growing rats of the Wistar strain. The rats were allowed to feed ad lib on a thiamine-free ration and given 20 micrograms thiamine by subcutaneous injection every two days. After 10 to 14 days of this regimen, a single dose of thiamine-^{14}C (243 millimicrocuries in 20 micrograms) was administered. Following injection of the labeled material, the animals were killed at designated times ranging from $^3/_4$ hour to 11 days. Urine collections were made at 1- or 2-day intervals. All rats retained beyond 2 days received injections of non-labeled thiamine on alternate days. Blood samples were collected on some animals at the time they were killed. Liver, kidney, heart, and brain were excised promptly after death and lyophilized. Tissue thiamine levels, except for brain, were below normal at the time the label was given. Some further decline during the course of the experiment indicates that the rats were in slightly negative thiamine balance. From data on total ^{14}C activity in the urine, the biological half-life of thiamine was estimated to be about $6^1/_2$ days. Specific activities of the tissues rather closely paralleled the corresponding levels of total radioactivity. The kidney exhibited rapid decline following the peak value, with no sign of a plateau region. Specific activities of the liver showed a plateau during the time interval between 12 hours and 48 hours. Brain and heart both showed rather slow increases to their respective peak values. The brain was exceptional in that it took a long time (8 days) for any significant decrease to become apparent. (Disser. Abstr.)

2770 APPLICATION OF THE IRRADIATED HAMSTER TEST TO THE STUDY OF EXPERIMENTAL ALLERGIC ENCEPHALOMYELITIS. Kornblum, Joan (Univ. of Pennsylvania, Philadelphia). J. Immunol., 101: 702-10(Oct. 1968).

Lymph node cells taken from rats sensitized to guinea pig spinal cord produced delayed skin reactions when mixed with antigen and injected into irradiated hamsters. Node cells from normal unsensitized rats failed to elicit such lesions. The immunologic basis for the skin reactions was demonstrated by their specificity for the inducing antigen, the delay in appearance of responsiveness in the lymph node cells until 2 weeks following immunization of the donor (a time period corresponding to the lag prior to clinical symptoms in the donor), and finally by the failure of node cells taken from donors rendered neonatally tolerant to spinal cord to react when challenged with the antigen. It was shown in addition that sensitized lymphoid cells from a strain of rat genetically insusceptible to the expression of clinical EAE also failed to react against the antigen in the irradiated hamster test. This may reflect a deficiency in these cells of a chemical mediator of delayed hypersensitivity. (auth)

2771 EFFECT OF ^{60}Co GAMMA IRRADIATION ON ^{59}Fe LOSS IN STOOL. Miura, Takeo (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 573-8(Aug. 1968). (In Japanese).

Ten mice were injected intraperitoneally with $^{59}FeCl_3$ solution at 24 hours after 800 R whole-body ^{60}Co γ irradiation. Iron-59 loss in stools of irradiated group increased for four days. The decrease of ^{59}Fe incorporation into red cells and the increase of ^{59}Fe storage in the gastrointestinal epithelial cells resulting from irradiation would have resulted in the increased excretion of ^{59}Fe in stool. After the 4th day, the excretion of radioiron in the irradiated group was decreased and then increased, probably owing to the recovery of bone marrow radioiron uptake. Another ten mice received fractionated irradiation of ^{60}Co γ ray at 27 days after $^{59}FeCl_3$ solution intraperitoneal injection. Cumulative ^{59}Fe loss curve in stools of irradiated group and of control group showed no significant difference. Patients with rectal cancer and cancer of the cervix were given $^{59}FeCl_3$ solution in the period of fractionated γ irradiation. Their ^{59}Fe loss in stools was within normal limit. Solutions of $^{59}FeCl_3$ were injected intravenously into the two patients with cancer of the cervix and they were treated with 6000 R ^{60}Co γ rays at 14 and 15 day period after ^{59}Fe injection. Their ^{59}Fe loss rate in stools was within normal limit. Therefore, it was concluded that those doses did not cause the intestinal bleeding as far as these patients were concerned. (NSA of Japan)

2772 EXPERIMENTAL STUDIES OF THE EFFECT OF ^{60}Co IRRADIATION ON FAT ABSORPTION. Doi, Eisei (Kumamoto Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 590-603(Aug. 1968). (In Japanese).

The gastrointestinal tract is one of the organs most sensitive to irradiation. However, there has been no study of the effect of simple fractionated doses of irradiation to the abdomen on intestinal absorption. The effect of simple fractionated doses of ^{60}Co irradiation to the abdomen on intestinal fat absorption in rabbits was studied with the use of ^{131}I-triolein. In the two groups that received 200 R of ^{60}Co irradiation daily to the upper and lower abdomens, blood radioactivity levels did not decrease to a statistically significant degree. Fecal radioactivity did not increase after total doses of 4000 R, but apparently increased after total doses of 6000 R and 8000 R to a statistically significant degree in either group; fat absorption was found to be reduced after total doses of 6000 R and 8000 R. In the two groups that received 400 R of ^{60}Co irradiation daily to the upper and lower abdomens, blood radioactivity levels did not decrease to any degree. In the group in which ^{60}Co was applied to the upper abdomen, fecal radioactivity increase significantly after total doses of 2000 R irradiation. When applied to the lower abdomen, fecal radioactivity increased only slightly after total doses of 2000 R irradiation. But the increase of fecal radioactivity after 4000 R and 6000 R irradiation was statistically significant. Fat absorption was reduced after total doses of 2000 R. (NSA of Japan) (TSS)

2773 5-OH TRYPTAMINE CONTENT IN RAT BRAIN TISSUES X IRRADIATED IN VITRO. Lott, J. R.; Hines, J. F. (North Texas State Univ., Denton). Contract AT(40-1)-3270. Texas J. Sci., 20: 91-4(1968).

The 5-hydroxytryptamine (5-HT) levels were measured in parts of rat brain after high-dosage x irradiation. The thalamus (1.642

μg/g) and mid-brain (1.107 μg/g) areas contained the highest amount of 5-HT, as compared with the amounts from the cortex (0.659 μg/g) and pons-medulla (0.697 μg/g). The cerebellum contained the least amount of 5-HT (0.281 μg/g). The most significant changes in 5-HT content following 10-R x irradiation occurred in the pons-medulla and the thalamic tissues. A significant decrease in the 5-HT of the pons-medullary tissues was observed, but no significant changes were noted in the cortex, mid-brain, and cerebellum. Several events are considered in attempting to explain the changes in 5-HT in x-irradiated tissues. It is concluded that caution is needed in attempting to relate 5-HT changes with functional changes in the nervous system brought about by ionizing radiation. (BBB) (TSS)

2774 THE SALIVARY IODIDE TRAP IN MAN: CLINICAL APPLICATIONS. Harden, R. McG.; Alexander, W. D. (Western Infirmary, Glasgow). Proc. Roy. Soc. Med., 61: 647-9(July 1968).

The metabolic bases for studies of the salivary I trap by means of ^{131}I and ^{132}I are discussed briefly. The I trap in the salivary glands can be studied more readily than the thyroid trap. In saliva, I secretion is inorganic and can be accurately measured. In the thyroid gland, trapped I is organically bound, and drugs that inhibit binding may also affect the trap. The I and perchlorate ions both inhibit the I-concentrating mechanism. There is a linear negative relation between the saliva/plasma ^{132}I ratio and the logarithm of the dose of I and perchlorate. Higher doses of I are required to produce the same effect as perchlorate. The salivary and thyroid traps are similar and in goitrous cretins with congenital inability of the thyroid to trap I the salivary glands are similarly affected. The saliva/plasma I ratio is less than 1 and this ratio may be used diagnostically where this type of dyshormonogenesis is suspected. In hyperthyroid patients, the thyroid uptake of ^{131}I is high, and consequently the serum inorganic ^{131}I concentration low. The salivary ^{131}I concentration is proportional to the plasma level and is therefore also low. The $PB^{131}I$ in thyrotoxicosis is high and therefore the ratio salivary ^{131}I/plasma $PB^{131}I$ is low. In hypothyroidism the ratio is high. But this ratio has little advantage over the $TP^{131}I/PB^{131}I$ ratio; indeed, the salivary ratio has the disadvantage that it will be altered by changes in salivary flow rate and in salivary I trapping. This test is too indirect and cannot be recommended for routine clinical diagnosis. (BBB)

2775 CONTRIBUTION TO THE INVESTIGATIONS OF PERCUTANEOUS RADIOCONTAMINATION OF POULTRY. Begovic, Jevrosima; Zagorcic, Anica; Gligorijevic, J.; Draganovic, B.; Pavlovic, M. (Inst. for the Application of Nuclear Energy, Belgrade). Acta Vet. (Belgrade), 18: 141-6(1968). (In Slovak).

Investigations were carried out on White Rock chickens, aged ca two yrs. A mixture of $^{85}Sr-^{89}Sr$ (0.12 μCi/ml) served as contaminant and was dropped in quantities of 0.02 ml as follows; on the feathers of the neck, on the back and breast, and in the skin of the upper region of fingers. The contaminant was fixed by spontaneous drying at room temperature. Percutaneous radiocontamination and transcutaneous penetration were followed by autohistoradiography and radiometry. The results of radiometric measurements of contaminability of the skin showed that the concept of percutaneous contamination in poultry included the skin and its cover—feathers. From the total quantity of the activity on the skin with feathers, the degree of contaminability of epidermis was 1.4% in the neck area, and in the region of the back it was 1.1%, while it was 0.2% in the region of the breast. Autohistoradiographic investigations showed that in every contamination of epidermis the contaminant penetrated through the bulbous feathers into deeper layers and circulation. (auth) (TSS)

2776 EFFECTS OF IONIZING RADIATION ON THE ULTRASTRUCTURE OF COLLAGEN FIBERS. Bublitz, Gunter (Freie Univ., Berlin). Strahlentherapie, 136: 316-19(Sept. 1968). (In German).

Connective tissue fibers of rat tails were irradiated with 5000 to 20,000 R and the effects were studied immediately and 10 days after irradiation. There were no changes in the striations typical for the collagen fibrilles up to 20,000 R neither immediately nor 10 days after irradiation. The effects obtained with the much lower exposures that are generally used in radiation therapy of scar keloids, induratio penis plastica, etc., result not so much from a direct influence upon the mature hypertrophic elements of the connective tissue, but more from an influence upon the proliferation of connective tissue and the accompanying inflammatory events. (auth)

2777 THE RADIOLYSIS OF DILUTE SOLUTIONS OF LYSOZYME. II. PULSE RADIOLYSIS STUDIES WITH CYSTEINE AND OXYGEN. Davies, J. V. (Christie Hospital, Manchester, Eng.); Ebert, M.; Shalek, R. J. Int. J. Radiat. Biol., 14: 19-27(1968).

Pulse radiolysis was used for the study of transients formed from lysozyme solutions. Reactions of these transients with cysteine and oxygen were analysed kinetically. The rate constant for the reaction of lysozyme with e^-_{aq} was 5.2×10^{10} M^{-1} sec^{-1} and for lysozyme with OH was 3.1×10^{10} M^{-1} sec^{-1}. For the reaction of the lysozyme transient (λ_{max} 400 mμ) with cysteine and oxygen, the rate constants were 4.1×10^6 M^{-1} sec^{-1} and 3.38×10^8 M^{-1} sec^{-1} respectively. The corresponding figures for the lysozyme transient (λ_{max} 310 mμ) were 4.6×10^8 M^{-1} sec^{-1} and 1.6×10^8 M^{-1} sec^{-1}. These data are correlated with those obtained from steady-state radiolysis and elucidate an aspect of the known radiobiological oxygen effect. (auth)

2778 THE RADIOLYSIS OF DILUTE SOLUTIONS OF LYSOZYME. I. ENZYMATIC STUDIES RELATING TO THE OXYGEN EFFECT. Shalek, Robert J.; Smith, Charles E. (Univ. of Texas, Houston). Int. J. Radiat. Biol., 14: 9-17(1968).

The inactivation of lysozyme in solution followed dose-response curves that were neither linear nor exponential. Oxygen had a small protective effect. Addition of cysteine reduced radiation inactivation substantially in anoxic conditions. A mechanism was derived and a quantitative estimate of the relative rate constants for the reactions of a lysozyme intermediate with cysteine and oxygen is given. This was in agreement with the conclusions reached in the pulse radiolysis investigation reported elsewhere. (auth)

2779 IODINE BALANCE IN MAN. Harrison, Michael T. (Western Infirmary, Glasgow). Postgrad. Med. J., 44: 69-71 (Jan. 1968).

Iodine metabolism was studied in men and women with normal thyroid function under different conditions and in others with thyroid disorders. Balance studies were carried out in a metabolic ward under conditions of controlled intake of iodine. Iodine balances were carried out with two levels of iodine intake, a low level of 100 μg/day, which was near the minimal level at which equilibrium can be maintained, and 600 μg/day, above the normal intake of dietary iodine. On the lower intake the combined average urinary and fecal excretion of iodine was close to the intake, and 11 of the 13 normal individuals were in equilibrium or slightly positive balance. With the higher intake of iodine there was a positive balance in every case, which persisted for at least two months while the intake was maintained. The urinary excretion of iodine rose markedly, but the increase of fecal iodine, although significant, was lower than both the intake and urinary increases. This suggested that the small increase in fecal iodine may be derived not from the ingested iodine, but may represent a change in excretion of endogenous organic iodine in the form of thyroid hormone, in response to the increase of inorganic iodine intake. Fecal iodine was derived from circulating organic iodine, a pool about 500 μg which was replenished by thyroid hormone secreted from the gland, while the source of urinary iodine was the smaller inorganic iodine pool of about 50 μg that was supplied by dietary iodine and by deiodination of thyroid hormone. (BBB)

2780 THE EFFECTS OF UO_2^{2+} ON NEUROMUSCULAR TRANSMISSION AND MEMBRANE CONDUCTANCE (THE NATURE OF POSTJUNCTIONAL MEMBRANE RECEPTORS). Liu, Jane Hu. New York, Columbia Univ., 1968. 115p.

Thesis.

Uranyl (UO_2^{2+}) ions, known to have high affinity for phospholipids and to complex with the phosphoryl ligands of natural membranes, were studied in frog sartorious muscle–sciatic nerve preparations in vitro. UO_2^{2+} (10^{-7} to 10^{-5}M) increases the tension output of indirectly stimulated muscle preparations and lengthens the duration of muscle action potentials by decreasing the rates of rise and fall of membrane potential changes. These effects of UO_2^{2+} can be reversed by washing the muscle preparations with Ringer's solution containing 2mM phosphate buffer. UO_2^{2+} (10^{-6}M) microperfused to a surface endplate increases the frequency of miniature endplate potentials while decreasing the quantal units of acetylcholine released per nerve impulse from motor nerve terminals. UO_2^{2+} (10^{-5}M) caused neuromuscular block wherein prolonged endplate potentials were recorded at the neuromuscular junction. The sensitivity of the postjunctional membrane (tested by measuring membrane depolarization during microperfusion with carbamylcholine) was found to increase when UO_2^{2+} (10^{-8}M) was added to the bath. If UO_2^{2+} concentration was increased (10^{-7} to 10^{-5}M) postjunctional membrane sensitivity increased transiently and then declined. This transient sensitization did not occur when extracellular Ca^{2+} was raised to 10^{-2}M. UO_2^{2+} (10^{-7} to 10^{-5}M) increases then decreases the rate of rise of the endplate potentials. A quantitative study of the interaction between UO_2^{2+} ions and carbamylcholine showed that these ions compete for the same binding sites in the membrane. These and other results indicate that postjunctional membrane receptors are phosphate-containing macromolecules. The nature of the receptor as a Ca^{2+} complex

of a protein and a phosphate-containing macromolecule is discussed. (Disser. Abstr.)

2781 EFFECT OF BETA RAYS ON DNA SYNTHESIS AND MITOTIC ACTIVITY IN THE CORNEAL EPITHELIUM. Machemer, Robert; Schuster, Reinhold; Suechting, Peter; Buettner, Helmut (Univ., Goettingen, Ger.). Strahlentherapie, 136: 308-15(Sept, 1968). (In German).

The effect of β rays (600, 2400, and 6000 R) on DNA synthesis and mitosis in the corneal epithelium of rats was examined by determining the mitotic and labeling index. In the first six hours after irradiation, no modification of the labeling index was found, after 12 hours it was reduced to about 50%, because of an early radioinduced disturbance of the enzymes necessary for DNA synthesis. Three to seven days after irradiation the labeling index is higher than control values and remains elevated up to 28 days, as an expression of a higher ploidy. The mitotic index became normal in function of the administered dose, twelve hours to 14 days after irradiation. Modification of the relation of labeling to mitotic index in favor of the labeling index suggested a polyploidy mechanism. (auth)

2782 BLOOD PLASMA DYNAMICS OF ^{131}I IN VARIOUS EXPERIMENTAL CONDITIONS. Nicoletti, F.; Grasso, A. M.; Gasso, G. (Univ., Catania, Italy). Minerva Med. Sicil., 13: 66-9(Jan.-Mar. 1968). (In Italian).

The blood plasma dynamics of ^{131}I were studied in patients with various forms of schizophrenia. The experimental techniques are described. The results show that there is a noticeable increase in the blood plasma permeability during insulin coma induced with a single venous administration of insulin. In patients receiving simple E. S. there is a blood plasma passage of the ^{131}I showing a noticeable value of the radioactivity in the plasma. In patients receiving E. S. after preliminary intravenous administration of pentothal and succinilcholine chloride there is no significant amount of radioactivity in the plasma. (J.S.R.)

2783 RADIOIMMUNOLOGIC DETERMINATION OF ANTI-INSULIN ANTIBODIES BY THE METHOD OF ALCOHOL PRECIPITATION. Motta, L.; Lunetta, M.; Calcagno, G.; Lombardo, T. (Univ., Catania, Italy). Minerva Med. Sicil., 13: 127-36 (Jan.-Mar. 1968). (In Italian).

A new radioimmunological method for the determination of anti-insulin antibodies is proposed. The method is based on the alcohol precipitation. The first results from a group of normal subjects and diabetics with diverse insulin needs are presented. The validity of the method is discussed. Two cases of special interest are discussed in some detail. (tr-auth)

2784 FURTHER RESULTS OF DETERMINATION OF BIOLOGICAL HALF-LIVES OF RADIOACTIVE TRACERS FOR SPECIES OF BUGS WITH A DIFFERENT NUTRITIVE PHYSIOLOGY (HETEROPTERA: INSECTA). Schlagbauer, A. W. J. (Univ., Bonn). Int. J. Appl. Radiat. Isotop., 19: 757-63(Oct. 1968). (In German).

It was found that Pyrrhocoris and Rhodnius climinate $Na^{131}I$ faster than Oncopeltus and Rhinocoris. $^{86}RbCl$ is very quickly eliminated by Pyrrhocoris and Oncopeltus. $^{32}PO_4^{3-}$ is generally eliminated by all species somewhat faster than $Na^{131}I$. The shortest biological half-lives are obtained with water bugs. (auth)

2785 EFFECT OF IMMOBILIZATION ON BONE BLOOD FLOW ESTIMATED BY INITIAL UPTAKE OF RADIOACTIVE STRONTIUM. Semb, Helge (Malm General Hospital, Sweden). Surg. Gynecol. Obstet., 127: 275-81(Aug. 1968).

Bone radiostrontium uptake was studied in rabbits after injection of 30 μCi of ^{85}Sr in the ear vein. When the leg was immobilized for two hr, the uptake of the radioisotope was invariably lower on the immobilized side, but after one day of immobilization, the difference tended to disappear. When the leg was immobilized for seven days, the uptake was greater, but not significantly on the immobilized side. With exception of a few values found in the distal part of the tibia and the calcaneus, the uptake of ^{85}Sr definitely tended to increase on the immobilized side after 21 days of immobilization. In rabbits in which the leg was immobilized for two hr, the average difference in activity between arterial and medullary blood was greater on the immobilized side, suggesting a higher extraction of ^{85}Sr from blood passing through the bone on this side. After one and seven days of immobilization, no significant difference was found between the activity curves for bone marrow blood from the treated and the untreated side. Extraction of ^{85}Sr from the plasma flowing through the bone was thus roughly the same on both sides. The difference in activity between the arterial and the medullary blood was less on the treated side after 21 days of immobilization, suggesting a lower extraction of the Sr on the immobilized side in this group. (BBB)

2786 EFFECTS OF WHOLE-BODY X IRRADIATION ON NUCLEAR RNA POLYMERASE ACTIVITIES IN RAT TISSUES. Omata, Saburo; Ichii, Shogo; Yago, Nagasumi (National Inst. of Radiological Sciences, Chiba, Japan). J. Biochem. (Tokyo), 63: 695-700(June 1968).

RNA polymerase activity was investigated in isolated liver, testis, spleen, and thymus nuclei of rats after 650 R whole-body x irradiation. The RNA polymerase was considered to play an important role in the changes of RNA metabolism caused by irradiation. The Mg^{++}-dependent and $Mn^{++}/(NH_4)_2SO_4$-dependent RNA polymerase (nucleosidetriphosphate: RNA nucleotidyltransferase, EC 2.7.76) activities in liver-nuclei increased by about 40% over the controls 24 hr after irradiation of intact, ad libitum fed rats. The activities then fell to below levels during the 10 days postirradiation. Similar changes in the activity of liver RNA polymerase were observed after irradiation for fasted rats but not for adrenalectomized animals. Induction of RNA polymerase and tyrosine transaminase (L-tyrosine: 2-oxoglutarate aminotransferase, EC 2.6.1.5) by cortisol administration was not influenced by irradiation. The effects of irradiation on Mg^{++}-dependent and $Mn^{++}/(NH_4)_2SO_4$-dependent RNA polymerase activities in testis, spleen, and thymus of rats were also described. (BBB)

2787 IMMUNOGENICITY OF HUMAN SERUM ALBUMIN: DECAY IN THE NORMAL MOUSE. Britton, S.; Celada, F. (Karolinska Institutet, Stockholm). Immunology, 14: 503-9(1968).

The disappearance of immunogenicity of human serum albumin (HSA) was measured by injection of 1 μg of this protein in normal mice and by transferring to them, at intervals, a fixed number of HSA-sensitized syngeneic spleen cells. One hr prior to cell transfer the recipients were x-irradiated (500 R, whole-body) and repopulated with 10^7 pooled spleen cells obtained from syngeneic animals preimmunized with HSA in Freund's adjuvant. Subsequently the antigen-binding capacity of the serum was determined. This system allowed detection of the residual amount of immunogen present in the animal, since under these conditions the adoptive secondary response was proportional to the HSA available, and no antibody was formed by the host. The half-life of HSA immunogenicity was $17\frac{1}{2}$ hr. A similar rate of decline (T = $16\frac{1}{2}$ hr) was found by following ^{131}I coupled to the HSA in the circulation of the same mice. This demonstrated that the albumin antigen was not stored in an active form in nonpreimmunized mice. (BBB)

2788 TRANSFER OF ULTRAVIOLET LIGHT INDUCED THYMINE DIMER FROM PARENTAL TO PROGENY DNA IN BACTERIOPHAGE T1 AND T4. Sauerbier, Walter; Hirsch-Kauffmann, Monica (Univ. of Colorado, Denver). Biochem. Biophys. Res. Commun., 33: 32-7(Oct. 10, 1968).

The transfer of uv-induced thymine dimer ($\hat{\tau}$) from parental progeny DNA to progeny DNA of bacteriophage under conditions allowing or not allowing repair was investigated. Results showed that the majority, and possibly all, of the $\hat{\tau}$ was transferred from parental to daughter DNA in T1 and T4. The conclusions drawn from the observations were: The ratio of thymine dimer ($\hat{\tau}$) per lethal hit of five was not caused by a removal of $\hat{\tau}$ from DNA by a bacterial or a T4 specific mechanism since the majority of $\hat{\tau}$ was handed down to daughter DNA. As a rule, $\hat{\tau}$ did not interfere with DNA replication and presumably not with transcription since in single infection experiments $\hat{\tau}$ was transferred to daughter DNA and since the average burst size of the progeny lysates was around ten. HCR and v-gene repair did not indiscriminately remove $\hat{\tau}$ from DNA. If they did remove $\hat{\tau}$ then they did it only in a highly selective fashion, by-passing the nonlethal $\hat{\tau}$. Because of quantitative uncertainties, experimental results did not exclude the following possibilities: That one, or less, out of five $\hat{\tau}$ was lethal; that HCR or v-gene repair selectively excised only lethal $\hat{\tau}$ without affecting the majority of $\hat{\tau}$ that were nonlethal per se. The merit of the preceding experiments was in their ability to physically separate dead and surviving organisms, thus allowing the chemical analysis of the surviving fraction only. When repair was allowed, as in the case of HCR, multiplicity reactivation, and v-gene repair, an analysis of the fraction surviving due to repair was possible. Thus pitfalls that may arise from making observations on the total population of uv-irradiated organisms were avoided. (B.S.L.)

2789 THE EFFECT OF ^{60}Co γ-IRRADIATION ON THE TRYPTIC DIGESTION OF PHOSPHORYLASE b. Muszbek, Laszlo; Damjanovich, Sandor; Csaba, Bela (Univ. Medical School, Debrecen, Hungary). Biochim. Biophys. Acta. 167: 464-6(Oct. 8, 1968).

The effects of different allosteric effectors on the tryptic digestion of phosphorylase b (α-glucan phosphonylase) before and after ^{60}Co γ irradiation was investigated. Neither AMP or ATP,

glucose-1-phosphate nor glucose-6-phosphate had any effect on the tryptic digestion of casein; this indicated that these compounds did not directly influence the effect of trypsin. Various concentrations of AMP, ATP, and glucose-6-phosphate yielded a significant inhibition of tryptic digestion of phosphonylase b. However, 20 mM Glc-1-P did not decrease the action of trypsin on the substrate. The most effective protective compounds proved to be the AMP and Glc-6-P. A significantly higher ATP concentration was necessary to produce a similar protection. These findings indicated that the allosteric effector AMP, which has been known to be more effectively bound than ATP, was a better protective agent in this system. The γ-irradiation of phosphorylase b had no influence on tryptic digestibility of protein in the absence of additions. However, the ability of allosteric effectors to protect phosphorylase b against tryptic digestion was greatly influenced. It was concluded that radiation damage of phosphorylase b involved largely an effect on the allosteric sites with loss of ability to bind the effectors. Allosteric transitions or feedback sensitivity were rather sensitive to ionizing radiation even at doses that hardly influenced the original molecular conformation of the enzyme. (B.S.L.)

2790 ATTEMPTS TO LINK THE INTERRUPTIONS IN T5 BACTERIOPHAGE DNA WITH AN ENZYME FROM E. COLI. Moroson, H.; Anello, A. (Sloan-Kettering Inst. for Cancer Research, Rye, N. Y.). Biochem. Biophys. Res. Commun., 33: 1-9(Oct. 10, 1968).

Attempts to convert T5 DNA containing single strand breaks to a form that would sediment in a manner resembling ungapped DNA in an alkaline sucrose gradient were made. Experiments were carried out with T5 phage having additional breaks introduced in its DNA by ^{32}P decay, or by treatment with methylhydrazino, as well as x radiation. It was shown that partial repair of large numbers of single strand breaks introduced into Tr DNA by x radiation or T5 DNA by treatment with methylhydrazine could be observed by treatment with a crude enzyme extract from E. coli. Under similar conditions it was not possible to observe repair of natural breaks in the DNA of T5 phage, or repair of breaks caused by ^{32}P decay in T5 phage. (B.S.L.)

2791 PHOTOREACTIONS AT 3655 A LINKING THE 3-4 DOUBLE BOND OF FUROCOUMARINS WITH PYRIMIDINE BASES. Musajo, L.; Bordin, F.; Bevilacqua, R. (Univ., Padua). Photochem. Photobiol., 6: 927-31(Dec. 1967).

The photoreaction between native DNA and skin-photosensitizing furocoumarins, following uv irradiation (3655 Å) that caused the formation of a stable chemical linkage between the furocoumarin and the macromolecule was studied. By screening with the simple components of DNA, that is, bases, nucleosides, and nucleotides, it was shown that skin-photosensitizing furocoumarins photoreacted only with the pyrimidine compounds, yielding new fluorescent substances. Some of these new compounds were isolated in the crystalline state, especially those arising from the combination of psoralen with thymine, cytosine, and uracil. They were C_4-photocycloaddition products involving a double bond in the 4′-5′ position of the furanic ring of furocoumarin and in the 5-6 position of the pyrimidine base. The final photoproduct obtained from the combination of psoralen and cytosine was the psoralen-uracil photocompound that arose by deamination of cytosine. When these substances were irradiated with uv light (2537 Å) in glacial acetic acid at room temperature, they decomposed, yielding furocoumarin and the pyrimidine base. It was concluded that skin-photosensitizing furocoumarins photoreacted at 3655 Å with pyrimidine bases by a photocycloaddition. The positions engaged were the 5-6 double bond in the pyrimidines, whereas in furocoumarins both the double bonds in the 4′-5′ and 3-4 positions could be engaged, resulting in two different classes of photoproducts: fluorescent (addition at the 4′-5′ double bond) and nonfluorescent (addition at the 3-4 double bond). It was also established that photocompounds of both classes were formed by irradiating an aqueous solution of native DNA and psoralen at 3655 Å. (BBB)

2792 PREPARATION OF HIGH-QUALITY INTERFERONS BY THE AID OF STRAINS OF SMALLPOX VIRUS ATTENUATED IN CELL CULTURE PASSAGES. Mayr, A. (Ludwig-Maximilians-Univ., Munich). Zentralbl. Bakteriol. Parasitenk. Abt. I Orig., 202: 183-90(1967). (In German).

Use of uv irradiation to prepare highly active interferon is described. The interferon was prepared in chicken embryo fibroblast cultures by means of vaccinia virus of high cell culture passages (428th to 458th passage in chicken embryo fibroblast cultures) and canary pox virus of high cell culture passages (401st to 453rd). These cultures afforded more active interferon preparations than virus strains of correspondingly lower culture passages. As compared to Sindbis virus, interferons prepared from uv-inactivated vaccinia and canary pox virus of high cell culture passages reached titers up to 1:1024 and compared to vaccinia virus values up to 1:512 (plaque test with 20 to 40 plaque forming units). The technique of preparation and evaluation of the interferons is described in detail. At room temperature (about 20°C), the high-titer smallpox virus interferons remained fully active for two to five weeks, at +4°C two months, and at −20°C more than one yr. High-titer smallpox interferons, after local administration, seemed to influence the herpes simplex infection in humans (herpes of the lips) and viral pox of the udder of cattle. (BBB)

2793 UTILIZATION OF THYMIDINE AND DEOXYURIDINE FOR SYNTHESIS OF DNA THYMIDYLATE IN IRRADIATED TESTICULAR CELLS OF DROSOPHILA MELANOGASTER. Benes, L.; Magdon, E.; Winterfeld, Gisela (Inst. of Biophysics, Brno, Inst. of Cancer Research, Berlin). Folia Biol. (Prague), 14: 266-73(1968).

The utilization of ^3H-TdR, ^3H-UdR, and ^{14}C-UdR for synthesis of DNA thymidylate in the testicular cells of non-irradiated and irradiated Drosophila males was studied. After 30 minutes' labeling, the DNA in the cells of non-irradiated Drosophila displayed about three times higher tritium activity from ^3H-TdR than from ^3H-UdR. With ^{14}C-UdR, the concentration was approximately 150 times greater than the ^3H-UdR concentration, the rate of incorporation was the same as for ^3H-TdR. In Drosophila exposed to a dose of 1,500 R of x radiation, the labeling index, i.e., the entry of the cells into the S-phase, fell to about 55%. Parallel with the decrease in the labeling index there was a drop in the mean grain counts per cell, i.e., in the rate of incorporation of the labeled precursors. As distinct from the labeling index, in which there was no significant difference between ^3H-TdR and ^{14}C-UdR, the drop in the mean grain counts per cell in the ^{14}C-UdR experiment was smaller than on using ^3H-TdR. The experiments exclude the possibility that the conversion of dUMP to dTMP is the limiting factor in the synthesis of DNA thymidylate in irradiated testicular cells of Drosophila. (auth)

2794 DISTRIBUTION AND EXCRETION OF ^{63}Ni ADMINISTERED INTRAVENOUSLY TO RATS. Smith, J. Cecil; Hackley, Betty (Veterans Administration Hospital, Washington, D. C.). J. Nutr., 95: 531-6(Aug. 1968).

The distribution and excretion of ^{63}Ni administered intravenously was studied in 64 Sprague–Dawley female rats. Small quantities of tissues (50 to 75 mg) were acid-digested and ^{63}Ni was counted using a liquid scintillation system. Most (61%) of a single intravenous injection of ^{63}Ni was excreted via the urine within 72 hr, with a lesser amount appearing in the feces (5.9%). In addition, the ^{63}Ni activity in whole blood and plasma had completely disappeared by 48 hr with no accumulation in red cells. The relative distribution of the ^{63}Ni/g in fresh tissue was as follows: kidney > adrenal > ovary > lung > heart > eye > thymus > pancreas > spleen > liver > epidermis > gastrointestinal tract > muscle > incisor > femur = brain > adipose. However, in all tissues analyzed the ^{63}Ni decreased rapidly, and after 72 hr only the kidney contained significant amounts of ^{63}Ni. The ^{63}Ni distribution was compared with the blood volume of specific tissues. Correlation coefficients were 0.79, 0.76, 0.82, and 0.68 for intervals of 15 min, two hr, six hr, and 16 hr, respectively following intravenous injection of the isotope. Thus distribution of ^{63}Ni was directly dependent upon the relative blood volume of various tissues. (BBB)

2795 PYRIMIDINE DIMERS IN THE DNA OF PARAMECIUM AURELIA. Sutherland, B. M.; Carrier, W. J.; Setlow, R. B. (Oak Ridge National Lab., Tenn.). Biophys. J., 8: 490-9(Apr. 1968). (ORNL-P-3457).

Paramecium was used to study the production of thymine-containing dimers in the range of biological uv doses, the fate of dimers in cells incubated in the dark after irradiation, and the loss of photoreactivability of dimers with time after irradiation. It was found that cyclobutyl dimers were formed by uv irradiation of Paramecium DNA in vivo, that because of cytoplasmic absorption the number of dimers made in DNA irradiated in vivo was much lower than in DNA irradiated in vitro, that dimers were lost from animals incubated in the dark after irradiation, and that all the dimers that remained in the animals could be destroyed by photoreactivating illumination. These experiments, together with data on photoreactivation in Paramecium, supported by hypothesis that pyrimidine dimers in the DNA of P. aurelia played an important role in uv-induction of mutations. (BBB)

2796 EFFECTS OF EXCESS IODIDE ON THE METABOLISM OF THYROXINE IN THE RAT. Yamada, Takashi; Jones, A. Eric; Mothon, Stella (New England Medical Center Hospitals, Boston). Metab., Clin. Exp., 17: 612-19(July 1968).

Thyroid-blocking anions appeared to displace thyroxine (T_4) from its binding protein in vitro and increase the rate of turnover of T_4 in vivo in the rat. Therefore, excess iodide might

augment the rate of turnover of T_4 by interfering with the T_4-plasma protein interaction. An experiment was undertaken to test this concept. Muscle uptake of labeled T_4 ($^{131}T_4$) and starch gel electrophoresis were used to assess in vitro displacement of T_4 from plasma protein. Thyroidectomized, T_4-maintained animals were used to assess in vivo metabolism of T_4 in the presence of excess iodide. Iodide was found to increase the uptake of ^{131}I-T_4 by muscle only in the presence of rat plasma, suggesting that iodide displaced bound ^{131}I-T_4 from plasma protein. Starch gel electrophoresis and radioautography indicated a displacement of ^{131}I-T_4 from albumin-prealbumin zone when KI was present. In vivo, dietary KI produced a significant fall in serum protein-bound iodine and an increase in fecal radioactivity in thyroidectomized, T_4-maintained animals. It was thus confirmed that excess iodide augmented the turnover of T_4 by displacing T_4 from plasma protein and increased fecal loss of T_4. (BBB)

2797 PERSISTENCE OF IMMUNOGENICITY OF TWO COMPLEX ANTIGENS RETAINED IN VIVO. Britton, S.; Wepsic, T.; Moeller, G. (Karolinska Institutet, Stockholm). Immunology, 14: 491-501(1968).

The persistence of immunogenicity of lipopolysaccharide was studied by a transfer system in which immunized mice were lethally irradiated and repopulated with nonimmune syngeneic lymphoid and bone marrow cells at different times after immunization. Although it was commonly assumed that lethal irradiation abolished immunocompetence, it was reported that antibody producing cells were resistant to large doses of x irradiation. To test the effect of irradiation, the agar-plaque technique was used. CBA mice presensitized against sheep red cells or Escherichia coli were x-irradiated with 900 R and thereafter tested for the number of 19S and 7S plaque-forming cells (PFC) at various intervals. With sheep red cells the total number of 7S PFC per spleen decreased markedly (98.8 to 100%). The number of PFC per 10^6 spleen cells also decreased, but not to the same extent. Irradiated animals did not respond with an increased number of PFC after antigen injection in contrast to nonirradiated controls. The total number of 7S PFC in irradiated animals was the same or slightly above the normal level of background 19S PFC in nonantigen-injected animals. Irradiation had an even greater effect on the number of direct 19S PFC against E. coli endotoxin and detectable cellular antibody synthesis was almost abolished. Irradiation also decreased the number of PFC against sheep cells and E. coli antigens to levels lower or comparable with the normal background in nonsensitized normal animals. Sheep cells persisted in an immunogenic form for 14 days whereas the bacterial antigens remained immunogenic for at least 45 days. (BBB)

2798 OCCUPANCY PRINCIPLE FOR RADIOACTIVE TRACERS IN STEADY-STATE BIOLOGICAL SYSTEMS. Orr, J. S.; Gillespie, F. C. (Western Regional Hospital, Glasgow). Science, 162: 138-9(Oct. 4, 1968).

The occupancy principle is an important property of steady-state systems. This principle is defined as a relation among the parameters occupancy, capacity, and flow. A previous theoretical analysis of tracer dynamics by Bergner is here expanded to consider a wide application to biomedicine. (C.O.)

2799 ON THE CHEMICAL NATURE OF THE "LIPID RADIOTOXIN". Goncharenko, E. N.; Balbarzdys, Z. Ya.; Graevskaya, E. E.; Kovaleva, T. A.; Kudryashov Yu. B. (Moscow State Univ. Inst. of Higher Nervous Activity and Neurophysiology, Moscow). Radiobiologiya, 8: 497-506(1968). (In Russian).

Methods of thin-layer and gas chromatography, as well as the method of polarography, were used to obtain data indicating that the lipid radiotoxin represents a labile complex of substances consisting of hydroperoxides, epoxides, aldehydes, and ketones of higher fatty acids. Features of similarity and differences of chemical composition of the lipidradiotoxin preparations and lipids isolated from an autolyzed liver were detected. (JPRS)

2800 INFLUENCE OF ULTRAVIOLET LIGHT ON FROZEN AQUEOUS SOLUTIONS OF URACIL, ADENINE, AND THEIR NUCLEOSIDES. Lapinskaya, E. M.; Khenokh, M. A. (Inst. of Cytology, Leningrad). Radiobiologiya, 8: 489-96(1968). (In Russian).

It was shown in the work that aqueous solutions of uracil, adenine, and their nucleosides undergo photolysis at -78°C, forming a number of new products. A hypothesis was advanced on the separation of the bases from uridine and adenosine. (JPRS)

2801 SOME PROPERTIES OF DOUGH AND GLUTEN IN D_2O. Tkachuk, R.; Hlynka, I. (Board of Grain Commissioners for Canada, Winnipeg). Cereal Chem., 45: 80-7(Jan. 1968).

Extensigraphic, farinographic, mixing, and baking properties of dough in D_2O were described and compared with properties of dough in H_2O. Farinograph mixing behavior of D_2O gluten was also examined. Extensigraph curves with D_2O doughs showed a significant increase in resistance to extension, compared to doughs containing equimolar amounts of H_2O. For example, with a ten-min rest period, the maximum resistance to extension was 795 and 420 BU for the D_2O and H_2O doughs. Baking D_2O doughs produced a smaller loaf of 875 cm^3, since a comparable H_2O dough resulted in a 990 cm^3 loaf. During mixing of the doughs used for the baking studies, the work input was recorded. The D_2O dough required a higher work input of 6.5 W-hr for optimum development as compared with 5.5 W-hr for the H_2O dough. The decrease in loaf volume of the D_2O bread could not be interpreted to result only from a stronger dough structure caused by substituting D_2O for H_2O, since the gassing power of doughs containing D_2O was significantly lower. Accordingly, the smaller loaf volume of D_2O bread was due to both insufficient CO_2 production and a stronger dough structure. Farinograph studies indicated that the D_2O doughs possessed higher values for development time, band width, and stability for all of the doughs examined, compared to H_2O doughs. Gluten in D_2O, as compared to H_2O, showed a considerable increase in stability, and excessive oscillations were seen in the farinograph mixing curves. The consistence of the glutens in D_2O was similar to that in H_2O. Thus, it was concluded that hydrogen bonds play an important role in dough structure. (BBB)

2802 A SOURCE OF FALSE ^{131}I UPTAKE AND PROTEIN-BOUND IODINE VALUES IN DOGS. Thomson, Roderick A. E.; Michaelson, Sol M. (Univ. of Rochester, N. Y.). Contract W-7401-ENG-49. Amer. J. Vet. Res., 28: 1623-5(Sept. 1967).

Thyroid uptake of ^{131}I in dogs was determined 24, 48, and 72 hr after intravenous administration of 25 μCi of carrier-free ^{131}I. Thyroidal ^{131}I uptake patterns of normal male and anestrous female dogs indicated a noticeable increase in the 48-hr uptake value to that noted at 24 hr. In dogs during the period of proestrous bleeding, values were in the lower limits of normal values and relatively stable from 24 to 72 hr. Protein-bound iodine (PBI) values in dogs were significantly increased above normal limits following 2,6-diiodo-4-nitrophenol medication for hookworms, and did not return to normal limits for nine to 14 months. (BBB)

Ecology

Refer also to abstracts 2679, 2826, and 4490.

2803 (CEA-R-3434) DETERMINATION OF DIETS FOR THE POPULATIONS OF ELEVEN REGIONS OF THE EUROPEAN COMMUNITY TO BE USED FOR OBTAINING RADIOACTIVE CONTAMINATION LEVELS. FIRST RESULTS CONCERNING THE FOOD CONSUMPTION OF INDIVIDUALS CLASSIFIED IN NINE AGE-GROUPS. Ledermann, Sully; Lacourly, Guy; Garnier, Arlette; Cresta, Massimo; Lombardo, Enzo (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). June 1968. 56p. (In French). (EUR-3851). Dep.

The processing of the data given by the family food inquiry carried out in 11 regions of the European Community, permitted the determination of the food consumption of individuals classified in nine age-groups, to study the radioactive contamination levels in the food-chain. The statistical method used is described, and the tables for each region and for each age-group giving the mean weekly food-consumption and the contribution of each diet in nutrition principles, minerals, vitamins, trace elements, and calories. (auth)

2804 (NYO-3480-10) PHYSICAL AND BIOLOGICAL OCEANOGRAPHY OF A LUMINOUS BAY. Annual Progress Report, August 1, 1967-July 1, 1968. McElroy, W. D.; Seliger, H. H.; Fastie, W. G.; Carpenter, S. H. (Johns Hopkins Univ., Baltimore, Md. McCollum-Pratt Inst.). July 22, 1968. Contract AT(30-1)-3480. 40p. Dep. CFSTI.

Data on extended period measurements of concentrations of phytoplankton, zooplankton and bacterial populations in various parts of Oyster Bay are presented. Nutrient levels in surface and interstitial waters and the correlation with P. bahamense populations were measured. Measurements of reproduction rates of natural and confined populations of P. bahamense were also made. Rates of photosynthesis of P. bahamense populations as well as nannoplankton populations were measured; for these experiments both ^{14}C uptake and oxygen evolution were measured as separate functions of both organism concentration and ambient light intensity. Data are made available on total primary productivity in Oyster Bay. Measurements of extractable chlorophyll from both P. bahamense and nannoplankton populations were made From known extinctions of chlorophyll in solution, internal calibrations of fluorimeters were made to extend the range of sen-

sitivity of the assay. By virtue of detailed observations of circulation patterns and P. bahamense concentration distribution as well as small-scale dye studies, a self-consistent mechanism for the long-term stability of Oyster Bay was developed. A final model of a towable bioluminescence photometer was designed, constructed, tested, and preliminary large scale bioluminescence mapping data were accumulated. (B.S.L.)

2805 PROBLEMS OF SAMPLING DESERT ARTHROPODS BEFORE AND AFTER A THERMONUCLEAR CRATERING TEST. Gist, Clayton S. (Univ. of California School of Medicine, Los Angeles). Great Basin Natur., 27: 26-35(Apr. 22, 1967).

An analysis of selected arthropods near ground zero was made before and after a large thermonuclear device at the Nevada Test Site (Project Sedan) was detonated. The study was restricted to species that could be sampled readily with sunken can traps and that were known to be well represented in the test area. Possible changes in species composition or in relative abundance of species as a result of the test were sought. It was concluded that the only significant lesson that emerged from the above experience was that deducing real changes in arthropod populations on the basis of captures in traps was difficult and required a considerable sampling effort in order to avoid ascribing significance to differences that occurred simply due to chance. Species captured in the study were scorpions: Vejovis confusus Stahnke, Hadrurus hirsutus Wood; insects: Areniva apacha (Saussure), Stenopelmatus fuscus Thomas, Ceuthophilus spp., Trogloderus costatus LeConte, Eleodes hispilabris (Say), Pelecyphorus pantex Casey, and Eleodes spp. [(mostly E. armata (Le Conte))]. (B.S.L.)

Genetics and Cytogenetics

Refer also to abstracts 2738, 2919, 2982, and 2986.

2806 (SAN-632-3) ACTIVITIES OF NUCLEIC ACIDS AS A GENETIC PROBE. Progress Report, 1967-1968. Spizizen, John (Scripps Clinic and Research Foundation, La Jolla, Calif. Dept. of Microbiology). July 11, 1968. Contract AT(04-3)-632. 24p. Dep. CFSTI.

The genetic control of physiological events in sporulation of Bacillus subtilis was extensively investigated. Mutants defective in some aspect of the conversion of the vegetative state to the spore stage were analyzed genetically by transformation and transduction techniques. A map of these mutant loci in relation to other known genes is presented; circularity of the maps was inferred. A class of asporogenous mutants blocked in early sporulation events were of particular interest. The majority of these mutants appeared to be defective in a gene locus mapping in the terminal region of the genome adjacent to a number of lysine genes. Such mutants were unable to synthesize a number of proteolytic enzymes and an antibiotic substance that were normally made at the end of the vegetative cell growth period. Many of these mutants were defective in the citric acid cycle enzymes functionally required for sporulation and were sensitive hosts for certain bacteriophages that could not replicate in wild type or asporogenous mutants. (B.S.L.)

2807 INDUCTION OF TEMPERATURE-SENSITIVE MUTANTS IN THE EXTRACELLULAR BACTERIOPHAGE AR1 OF BACILLUS SUBTILIS BY UV-RADIATION. Azizbekyan, R. R.; Kriviskii, A. S. (Inst. of Molecular Biology, Moscow). Genetika, 4: 120-8(Oct. 1968). (In Russian).

The mutagenic action of uv radiation and nitrous acid on AR1, the extracellular phage of Bacillus subtilis, was investigated. UV rays (λ 2537A, dose 750 erg/mm^2, survival of the phage 1%), as well as the treatment with nitrous acid, increases by about six times the frequency of temperature-sensitive (ts) mutants among the surviving phages. The frequency of ts-mutants in the nonirradiated control was also quite perceptible (~2%). The preparations of the cloned phages, obtained by means of consecutive transfers from separate plaques with the subsequent propagation at 37° and +45°C, differed from the initial phage by a significantly lower content of ts-mutants, both spontaneous and uv-induced. It is shown that this difference between the initial phage AR1 and the preparations of the cloned phages are not the result of any kind of senescence (that could be accompanied by the occurrence of mutations) or of the propagation of ts-mutants in the course of transfers. On the basis of the experimental studies on the mutagenic effect of uv-radiations on phages, propagated from different dilutions of the initial material, it is assumed that the latter is a mixture of low and highly mutable clones, the frequency of the latter never exceeding 0.001. (auth)

2808 MODIFYING EFFECT OF HIGH TEMPERATURE ON THE GENETIC RESULTS OF IRRADIATION OF BARLEY SEEDS WITH X-RAYS. Babayan, R. S. (Lab. of Radiation Genetics, Erevan). Genetika, 4: No. 10, 36-40(Oct. 1968). (In Russian).

The effect of 30 min exposure of barley seeds to high temperature (+80°C) on the results of the subsequent irradiation with x rays at 15 and 20 kR doses was studied. The heating of seeds prior to irradiation has a protective effect on germination and survival of seeds, as well as on seed setting in M_1. The heating of seeds, both pre- and post-irradiational, results in a two- to four-fold increase of the frequency of chlorophyll mutations, in particular of the albino-type mutation. (auth)

2809 ULTRAVIOLET IRRADIATION STUDIES ON THE CYTOPLASMIC DETERMINANT OF THE YEAST MITOCHONDRION. Maroudas, N. G.; Wilkie, D. (University Coll., London). Biochim. Biophys. Acta, 166: 681-8(Oct. 29, 1968).

Ultraviolet induction of the cytoplasmic petite mutation in yeast was studied under a variety of growth conditions both before and after irradiation. The induction curves were found to be single-event for anaerobically grown cells, and multiple-event for aerobic cells. By using a split dose technique, both photo-reactivation and dark-repair were investigated. No significant difference in repair ability was found between aerobic and anaerobic cells. A target theory interpretation of the induction curves suggests that mitochondrial DNA, assumed to be the genetic determinant, exists as a single heritable unit in anaerobic cells, and as multiple units in aerobic cells; moreover, the number of genetically effective copies in the aerobic cells appears to be far smaller than the number of mitochondria. These results are shown to be in accord with an independent estimate of the number of cytoplasmic determinants derived from recent genetic studies on mitochondrial recombination in aerobic and anaerobic yeast cells. (auth)

2810 TWO DWARF CASTORS THAT ARE GREAT IN PERFORMANCE. Kulkarni, L. G.; Ankineedu, G.; Sarma, V. S. (Indian Agriculture Research Inst., Hyderabad, India). Indian Farming, 16: No. 9, 18-19(1966).

Dwarf and short mutants were isolated from the progenies of castor beans resulting from irradiation of the parent with γ rays (10,000 R) and 2.5×10^{12} n/cm^2 fast neutrons, respectively. Under maximum potential conditions of proper sowing, close spacing, use of adequate fertilizers, etc., the dwarf mutant can yield 1,000 kg of seed and the short mutant 1,500 kg of seed compared with 600 kg of seed of the parent. (Indian Sci. Abstr.)

2811 FREQUENCIES OF CERTAIN TYPES OF GAMMA RAY-INDUCED MUTATIONS IN POTATO. Nayar, N. M.; Pushkarnath; Hakim, K. L. (Central Potato Research Inst., Simla, India). Indian Potato J., 7: No. 2, 76-80(Oct. 1965).

The second vegetative generation populations of three Indian varieties (Kufri Kumar, Kufri Kuber and Kufri Safed) comprising 2,059 plants derived from 330 original tuber units treated with 500, 1,000, 3,000, and 5,000 rads of γ rays at 10,000 rads/hour were scored for eight characters, qualitative and quantitative. A general increase in mutability rate was observed with increase in dosages except at 500 rads. The percentages of mutated tuber progenies, individual plants, and of induced mutated characters ranged from 28.6 to 66.7, 5.4 to 21.5, and 0.8 to 3.3, respectively, and the percentages of mutations per vM_2 families and plants ranged from 37.5 to 150.0 and 6.9 to 22.8, respectively. Differences in radiosensitivity between varieties were not observed but characters showed large differences in mutability rates. Vigor and stem-pigmentation were the characters most affected (more than 75 per cent of all mutations). Leaf venation was not affected by any of the treatments. In potato, the frequencies of induced mutations compared well with those of seed-propagated plants, but the spectrum of mutations appeared to be narrow. The tetraploid nature of the species acts as a buffer for radiation tolerance. This, together with the asexual mode of propagation, may be responsible for the observed narrow mutation spectrum. The occurrence of a somewhat higher frequency of induced mutations at the lowest dosage employed may be the result of weakened intrasomatic competition. The consequences of this phenomenon are explained. The possibilities of using mutation breeding in a vegetatively-propagated, polyploid crop plant like the potato are discussed and it was suggested that mutation spectrum could be increased by employing suitable techniques as inducing irradiated tubers to produce successive crops of sprouts, using chemical mutagens, and neutron irradiation, alternating asexual and sexual modes of reproduction, employing recurrent irradiation, and through use of polyhaploids. (auth)

2812 RADIOSENSITIVITY OF CHROMOSOMES IN FIBROBLASTS OF DIFFERENT MAMMALIAN SPECIES AND STRAINS IN VIVO AND IN VITRO. Osetrova, T. D.; Morozova, L. M.; Kerkis, Yu. Ya. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Genetika, 4: No. 10, 85-92(Oct. 1968). (In Russian).

Comparative studies on the radiosensitivity of identical tissues in vivo and in vitro in various mammalian species and inbred strains made it possible to establish the relative role of intra-

cellular mechanisms and systems operating at the level of the organism as a whole in the determination of the radiosensitivity of chromosomes in individual cells. Investigations of radiosensitivity were carried out on embryonal fibroblasts of selected mice strains (BALB, C_{57}BL) and non-selected white rats in vivo and in vitro, following the irradiation at a 50 R dose. As it was shown by the analysis of the spontaneous mutability and radiosensitivity of the chromosomes of embryonic fibroblasts, not only the interspecific differences in the rate of spontaneous mutability and in the radiosensitivity of chromosomes, but the differences between the strains as well, can be detected in isolated cells. This is indicative of the existence of certain intracellular mechanisms determining these differences. It was shown by the comparison of the frequencies of the spontaneous and radiation-induced chromosome aberrations in vivo and in vitro, that the frequency of spontaneous aberrations can be either the same in vivo and in vitro or somewhat higher in vitro; the radiosensitivity of chromosomes in all the animals studied proved to be higher in vitro than in vivo. This suggests the existence of a complex interaction between the mechanisms determining the mutability of chromosomes and operating at the cell level on one hand and, on the other hand, those acting at the level of the organism as a whole. The relative role of each of these mechanisms is different in different mammalian species and strains. (auth)

2813 INDUCED MUTATIONS IN POLYGENIC SYSTEMS. **Aastveit, Knut (Inst. of Genetics and Plant Breeding, Vollebekk, Norway). Hereditas, 56: 20-6(1966).**

A highly inbred line of Drosophila melanogaster, that showed no response to selection for high and low sternoplural chaetae number, was irradiated with 1500 R of ^{60}Co γ rays or treated with repeated low doses of EMS (ethane methyl sulfonate). The induced genetic variation was measured by the response of the populations to two-way selection. In the γ-ray experiment a clear response was obtained, in negative as well as in positive direction. After irradiation the males and females were mixed and mass cultured for two generations without selection, to stimulate recombination. Mass selection for high and low chaetae number was then started and continued over 20 generations. In the EMS experiment the flies were cultured every second generation on the standard medium to which was added 4 ml EMS/1. Two-way selection was started in the generation following the first treatment. In the EMS-treated lines no response to selection was obtained in the line selected for high number of sternoplurals. In the low line there was a clear and significant response. The results confirmed earlier results in barley, namely that irradiation followed by selection could change the mean in negative as well as in positive direction. Although negative mutants were in general, most frequent, at least five or six cases occurred in which a typical quantitative character, such as grain yield, increased 5 to 10%. An increase of the same magnitude was represented by the high selection line in the present γ-ray experiments. If changes were induced in various members of a polygenic system, further changes of the mean than those obtained in a single mutation step should be possible by recombination. And since recombination was more easily favored in a crossfertilizing species, such species should offer greater possibility for large shifts in the mean. (BBB)

2814 MODIFICATION OF LETHALITY AND MUTAGENESIS BY GROWTH INHIBITION OF ULTRAVIOLET-IRRADIATED ESCHERICHIA COLI STRAIN B/R. **Hill, Ruth F. (Columbia Univ., New York). J. Gen. Microbiol., 52: 261-70(July 1968).**

Effects of postirradiation growth inhibition on survival and absolute yields of prototrophic mutants were studied in E. coli B/R, uv irradiated in the lag and logarithmic phases of the growth cycle. Without postirradiation growth inhibition, survival, and yields of mutants were higher for logarithmic phase cells. Postirradiation growth inhibition reduced yields of mutants from both types of cells to similar extents and markedly increased the survival of logarithmic phase cells, both after small and large uv doses. In lag phase cells, a survival increase mediated by postirradiation growth inhibition could only be observed after a large uv dose or by inhibition of repair of damage occurring after plating for colony formation. Postirradiation growth inhibition had two effects: one tending to increase survival and another tending to enhance lethality. Observable effects of postirradiation growth inhibition on survival and induced mutation in E. coli B/R and whether or not such effects were correlated depended upon a number of factors. These included the relative amounts of repair occurring during growth inhibition and during subsequent growth; heterogeneity of the population with respect to growth phase, intrinsic repair ability and amount of damage; and relative contributions of increased repair and increased killing, both mediated by postirradiation growth inhibition. (BBB)

2815 ANNUAL REPORT, CYTOGENETICS LABORATORY, DEPARTMENT OF BOTANY, UNIVERSITY OF CALCUTTA. **Sharma, Archana; Sarkar, Amiya Kumar, (eds.). Res. Bull. Univ. Calcutta, 1: 1-45(1966).**

The effects of ionizing and nonionizing radiations on chromosomes of plants are reviewed. Radioinduced chromosome breakage was observed in Nigella sativa, no preferential breakage of the secondary construction being noted. When x rays were applied to six different species of Amaranthus, chromosomal abnormalities were common. Similar effects in all the strains were attributed to similar chromatin matter in all. Other studies demonstrated the influence of the genome on radiosensitivity in different pulses such as Lathyrus sativus, L. odoratus, Lens esculenta, and Allium cepa, Impatiens balsamina, and Solanum nigrum. Colichiploid members of Allium and Impatiens, naturally occurring tetraploid individuals of Solanum nigrum, and the pulses mentioned above with uniform chromatin contents were subjected to ^{32}P and ^{35}S. Polyploid strains, in general, were less prone to radiation damage. The three pulses presented a uniform response, but Lathyrus species were more sensitive to radiation than Lens esculenta. When germinating seeds of Basella rubra, Beta vulgaris, Canavalia ensiformis, and Dolichos lablab were subjected to 10,000 and 20,000 R of x rays, at the higher dose lethality was observed whereas at lower doses mixoploids were obtained. With seeds of Verbena hybrida var. giant, lower doses failed to yield any significant effect whereas treatment with 15,000 R gave phenotypic abnormalities at the juvenile stage during germination. Leaf size, stomatal frequency, flower size and shapes were altered. Low doses of x rays on the germinating seeds of Petunia violacea gave fragments (13.6%), clumping, early separation, and nondisjunction among the chromosome abnormalities noted. Several mutants were obtained with stunted growth and thick, coarse leaves. A high frequency of meiotic irregularities was also recorded from meiosis. (BBB)

Health Physics and Safety

Refer also to abstracts 2238, 2417, 2457, 2555, 2595, 2644, 2673, 2674, 2740, 2775, 2860, 2889, 2893, 2919, 3025, 3534, and 4517.

2816 (A/AC.82/G/L-1170) O ZAGRYAZNENII RASTITEL'NOSTI PRODUKTAMI DELENIYA TYAZHELYKH YADER. (Contamination of Vegetation by the Fission Products of Heavy Nuclei). **Rosyanov, S. P.; Gustova, L. I.; Gedeonov, L. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1967. 7p. (In Russian). Dep.**

The results of the determination of ^{90}Sr, ^{137}Cs, ^{144}Ce, and ^{95}Zr–Nb in vegetable and fallout samples, collected during 1962 to 1963 in the Leningrad area, are reported. It was shown that the grassy vegetables retained only 20% of the ^{90}Sr and ^{137}Cs precipitated from the atmosphere. The contamination of plants depended on their age. (tr-auth)

2817 (AD-671660) COMPUTATIONAL TECHNIQUES IN BETA DOSE PROBLEMS. Final Report. **Brown, Stephen L.; Yu, Oliver S. (Stanford Research Inst., Menlo Park, Calif.). Jan. 1968. Contract N00228-67-C-1143. 121p. (USNRDL-TRC-68-13; OCD-3119-A). CFSTI.**

The premise that β radiation can present significant hazards to small, unprotected organisms is examined. Two generalized methods for calculating β doses are discussed, and specific numerical calculations and results are given for simple emitter-absorber geometries. The sample results strongly indicate that β dose would be an important component of the hazard from radioactive contaminants in the circumstances posited. (auth) (USGRDR)

2818 (CEA-R-3417) EXPERIMENTAL STUDY OF CONTAMINATION BY INHALATION OF RADIOACTIVE IODINE AEROSOLS. BIOLOGICAL BALANCE. **Marble, Georges (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1968. 25p. (In French). Dep.**

Thesis. Submitted to Univ., Paris.

Several articles were published concerning research into contamination produced by inhalation of radioactive iodine aerosols in monkeys. Results dealing with the biological balance of this contamination are presented and discussed in this report. (auth)

2819 (CEA-R-3432) LITERATURE STUDY OF THE RADIOBIOLOGICAL PARAMETERS OF ^{137}Cs REQUIRED FOR EVALUATING INTERNAL IRRADIATION DOSES AS A FUNCTION OF AGE. **Garnier, Arlette (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). July 1968. 58p. (In French). (EUR-3852). Dep.**

A literature survey on radiobiological parameters of ^{137}Cs, necessary for the estimate of the internal irradiation dose of man according to his age (during growth), is discussed. The data are completed by a commented review of the mathematical models, proposed in order to value the irradiation doses from ingested cesium and the biological parameters. (auth)

2820 (JAERI–1165) SURFACE CHEMICAL STUDIES OF RADIOACTIVE CONTAMINATION AND DECONTAMINATION OF SOLID SURFACES. Wadachi, Yoshiki (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). May 1968. 32p. (In Japanese and English). Dep.

The mechanisms of radioisotope aqueous solution contamination and its decontamination of solid surfaces were studied by surface chemical techniques. Solid surfaces were classified into permeable (cotton cloth) and impermeable (metal, paint, plastic) surfaces, concerning radioisotope aqueous contamination, and the mechanisms of contamination were classified considering also their decontamination. The mechanisms of decontamination were classified according to the actions of decontaminants. Based on these classifications, the mechanisms of solid surface radioactive contamination and decontamination were studied systematically by means of the washing of radioisotope contaminated surfaces with water, surfactants and decontaminants. In addition, studies were carried out on the mechanisms of the contamination and decontamination of solid surface (active carbon powder) which is difficult to classify into permeable or impermeable surface. (auth)

2821 (NP–17597, pp 137–50) PROTECTION AND SAFETY. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — research activities on radiation protection and safety, 1967 summary of

RADIATION PROTECTION, SAFETY, REACTOR SAFETY, RADIATION DOSIMETRY, HEALTH PHYSICS — research activities on, 1967 summary of French (H.D.R.)

2822 (RA–33) ^{90}Sr AND ^{137}Cs IN THE HUMAN DIET IN THE NETHERLANDS DURING 1964. Mattern, F. C. M.; Drost, R.; Strackee, L. (Rijks Instituut voor de Volksgezondheid, Bilthoven (Netherlands). Laboratorium voor Stralingsonderzoek). June 1968. 27p. Dep. CFSTI.

Results of measurements of ^{90}Sr and ^{137}Cs in a number of foodstuffs are reported. The yearly mean of the daily dietary intake of ^{90}Sr and ^{137}Cs in the Netherlands was estimated as 37.6 pCi/day and 220 pCi/day respectively. The computation of the estimated values from the national food balance sheet is described in some detail. (auth)

2823 (RT/FIMA–(68)3) "CONDOS" SYSTEM FOR THE MEASUREMENT AND AUTOMATIC AUDITING OF THE RADIATION EXPOSURE. Esposti, A. Degli; Martelli, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 45p. (In Italian). Dep.

The organization of an automatic system for the processing of personnel monitoring data is described. The system, designed for the IBM-7094 and the IBM-1401 computers, yields up to date records of the individuals controlled at the personnel Dosimetric Service of the CNEN. External radiation doses, received during fixed time intervals, are calculated and compared with maximum permissible values; furthermore, statistical evaluations on population groups can be carried out. (auth)

2824 (TT–66–51033/4) HYGIENE AND SANITATION. Translation of Gigiena i Sanitariya, 30: No. 10, 3–126(1965); No. 11, 3–115(1965); No. 12, 3–100(1965). 474p. (IPST–Cat.–1544–1546). CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2825 (TT–67–51409/2) HYGIENE AND SANITATION. Translation of Gigiena i Sanitariya, 32: Nos. 4–6, (1967). 481p. (IPST–Cat.–1784–1786). CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2826 (UCD–34–P–104–12) STRONTIUM–90 AND ^{137}Cs FOOD CHAIN RELATIONSHIPS TO DEER AND SHEEP. V. FACTORS INFLUENCING RADIONUCLIDE ACCUMULATION. Progress Report, June 15, 1967–June 16, 1968. Longhurst, William M.; Kepner, Richard E. (California Univ., Davis). June 28, 1968. Contract AT(11–1)–34. 68p. Dep. CFSTI.

Detailed accounts are presented of research progress in the following areas: investigation of, by means of gas chromatography, the volatile compounds in forage plants that are important in determining palatability for deer and sheep; measurement of the effect of fertilization upon the palatability, digestibility, and concentration of various aromatic compounds of Douglas-fir; determination of why new Douglas-fir shoots are more palatable to deer than old-growth needles; determination of deer and sheep preference for seven oak species, as indicated by voluntary consumption; determination of the role of the sensory systems in forage selection and voluntary consumption by sheep; confirmation of earlier findings concerning the effect of essential oils from unpalatable plant species on microbial activity; determination of which of the individual oxygenated monoterpenes in bay oil inhibit rumen microbial activity; investigation of the effect of varying dietary regimes on the fermenting capacity of the reticulorumen, omasum, caecum, and anterior colon and on the VFA concentration in the various parts of the alimentary tract. Comparison of the deposition of radioisotopes in tissues of adult deer and sheep, recycling of isotopes (particularly their disappearance from blood and concentrations in parotid saliva), transfer of the isotopes across the placenta to fetal tissues, transfer of isotopes through the milk to the nursing young; comparison of ^{137}Cs accumulation in deer inhabiting chaparral and oak woodland vegetative types; and determination of current ^{90}Sr levels in yearling deer as a continuation of the long term series dating back to 1950. (B.S.L.)

2827 A SUGARVEDELMI ELLENORZES MODSZEREI. I [AND] II. AZ EOETVOES LORAND FIZIKAI TARSULAT SUGARVEDELMI SZAKCSOPORTJA SZERVEZESEBEN 1964 OKTOBER 19–24, KOEZOETT MATRAFUEREDEN TARTOTT OSZI SUGARVEDELMI, ISKOLAN ELHANGZOTT ELOADASOK GYUEJTEMENYE. (Environmental Radiation Control. I [and] II. Proceedings of the Conference on Radiation Control held October 19–24, 1964 at The Health Physics School, Matrafuereden, Hungary). Erno, Bujdoso; Zsigmond, Makra; Lajos, Toth [(eds.)]. [Budapest] Koezponti Fizikai Kutato Intezet, 1965. 473p. (CONF-641029–(Vols. 1 and 2); KFKI–2043).

The 27 papers contained in the two volumes of these proceedings deal with the protection of radioactive materials handling personnel who are exposed to radiation hazards, and with the estimation of population burdens resulting from nuclear explosions. The first papers discuss generalized concepts of radiation dosimetry (including units and quantities), basic safety standards for radiation protection, permissible body burdens, and maximum permissible concentrations of radioisotopes in air and water for occupational exposure. Health physics instrumentation (scintillation, ionization, and semiconductor chambers and counters), γ sources, radioisotope laboratory techniques, and methods for neutron dose-rate determination (moderator neutron dosimeter) are discussed in several papers. Responses of silver-activated phosphate glass to α-, β-, γ-, and neutron-irradiation and thermoluminescent dosimetry with CaF_2 and LiF are also discussed in the papers on health physics. The interpretation of bioassay data, excretion of uranium, strontium, and radon from the body, uptake of ^{210}Po, Ra, and U dusts by inhalation, assessment of radioactive cesium in man, and use of urinary uranium as an indicator of dose in exposed personnel are analyzed. The second volume deals mainly with rules and regulations regarding decontamination and waste disposal. Evaluations and estimations of exposure criteria in cases of accidents in large nuclear plants or massive fallout are also discussed. (R.V.J.)

2828 SOME LONG-LIVED RADIONUCLIDES IN MARINE ORGANISMS ON THE PACIFIC COAST OF JAPAN. Tsuruga, Hanato (Tokai Regional Fisheries Research Lab., Tokyo). J. Radiat. Res., 9: 63–72(June 1968).

The analytical procedure for the radionuclides of Mn, Fe, Co, Zn, Zr, Ru, and Ce in biological materials was improved and these radionuclides in marine organisms in the coastal waters of Japan collected in the period of 1964 to 1966 were analyzed. The marine biota examined consisted of plankton, benthic algae, molluscs and fishes, and freshwater organisms were also analyzed for comparison. The radionuclides, ^{55}Fe, $^{106}Ru + ^{106}Rh$ and $^{144}Ce + ^{144}Pr$, were recognized as the main contaminants in the organisms, and their concentrations were generally higher in organisms in open seashore than those in estuary or embayment. The presence of $^{106}Ru + ^{106}Rh$ and $^{144}Ce + ^{144}Pr$ was observed commonly in plankton, littoral seaweeds and benthic molluscs, whereas these radionuclides were negligible in the muscle of nektonic organisms. The concentrations were particularly high in red algae, Gelidium spp., and benthic molluscs. In the latter the concentration of $^{106}Ru + ^{106}Rh$ was higher than that of $^{144}Ce + ^{144}Pr$, which was reverse to the relative concentration in sea water, and the major portion of these radionuclides was found in the viscera. In the muscle of nekton, ^{55}Fe was dominant and in the mackerel a value ten times higher than those in the bottom fish, shark, and squid was observed. Manganese-54 was found in the oyster and fan shell which were collected respectively in estuary and embayment, and also in a bottom fish, Beryx splendens. Cobalt-60 was detected in red algae, Gelidium spp.,

hard clam and top shell in open seashore, but ^{65}Zn was found in none of the organisms assayed here. (auth)

2829 ROUTINE SURVEILLANCE FOR RADIONUCLIDES IN AIR AND WATER. Geneva, World Health Organization, 1968. 64p. $2.75; Sw. fr. 8.-.

Principles, purposes, and objectives of routine environmental surveillance by government authorities are discussed. The importance of uranium and thorium and their decay products as sources of natural radiation in the atmosphere and water is discussed. With regard to human exposure to isotopes in air and water, the most important isotopes are ^{210}Bi, ^{210}Pb, ^{210}Po, ^{220}Rn, and ^{222}Rn. Man-made sources of contamination of the environment include nuclear test explosions and radioactive waste products from medicine and industry. Radioactive wastes from reactor fuel operations include isotopes of protactinium, radium, polonium, and bismuth. Factors influencing the behavior of radioactive liquid and gaseous waste discharges in the environment are discussed. Internal and external pathways of exposure of man are discussed. A table is presented of fission products important on account of yield and half-life. Methods of sampling and analysis of air and water are described. Staff, instrumentation, and general requirements for an environmental surveillance laboratory are discussed. (H.L.W.)

2830 CODE OF PRACTICE FOR THE PROTECTION OF PERSONS EXPOSED TO IONISING RADIATIONS IN RESEARCH AND TEACHING. Second Edition. London, Her Majesty's Stationery Office, 1968. 70p. 6s. 6d.

Topics covered include: Scope of application of code; administrative organization; suitability of buildings; precautions of general application; control of effectiveness of protective measures; medical supervision; special precautions with x-ray installations and other apparatus emitting ionizing radiations; special precautions with sealed sources; special precautions with unsealed radioactive substances; special precautions with nuclear reactors and criticality experiments; emergency procedure; storage of sealed sources and unsealed radioactive substances; transport, disposal of radioactive waste; definitions. (UK)

2831 ACCUMULATION OF ^{137}Cs BY TRICHODERMA VIRIDE RELATIVE TO ^{137}Cs IN SOIL ORGANIC MATTER AND SOIL SOLUTION. Witkamp, Martin (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Soil Sci., 106: 309-11 (Oct. 1968). (ORNL-P-3594).

Small nylon bags containing decomposing litter or wood of tulip poplar trees labeled with ^{137}Cs were immersed in a nutrient solution. Spores of the fungus, Trichoderma viride, were placed in the solution, and after one week the mycelia growing on the bags and in the surrounding liquid were analyzed for ^{137}Cs content. The concentrations of ^{137}Cs in mycelium on solid substrate were invariably higher than those in mycelium from liquid. This may be a result of additional available ^{137}Cs in the bags relative to that in the liquid; of higher mineral concentration at the solid surface than in the liquid; of higher metabolic activity of fungi in contact with the solid surface; or of a higher proportion of aerial mycelia and spores on the solid than in liquid media. (H.L.W.)

2832 GUIDE PRATIQUE POUR L'ORGANISATION DE LA SURVEILLANCE DE LA CONTAMINATION RADIOACTIVE DES DENREES ALIMENTAIRES ET DES BOISSONS. (Practical Guide for the Organization of Monitoring Radioactive Contamination of Foodstuffs and Beverages). Brussels, European Atomic Energy Community, 1967. 54p.

The relation between the radioactive contamination of the environment and the corresponding level of the contamination of foods varies as a function of a large number of factors. Several groups of foods — milk and its derivatives, cereal and cereal products, meats, legumes, fruits, and potatoes, fish, and beverages — were studied with respect to the principal factors that could affect the monitoring of their radioactivity. The sampling, techniques of measurement and analysis, and presentation of data were considered. The principles and techniques developed by this study are presented in systematic form. (J.S.R.)

2833 ^{226}Ra CONCENTRATIONS IN PUBLIC WATER SUPPLIES. Hickey, John L. S.; Campbell, Samuel D. (Public Health Service, Washington, D. C.). Public Health Rep. (U.S.), 83: 551-7(July 1968).

To identify population groups consuming water with a relatively high Ra content (>3 pCi/l), selected public water supplies were analyzed for ^{226}Ra. The principal objective of the study was to identify compact populations which could serve as a base for epidemiologic studies of the effects of chronic Ra ingestion at low levels. Also, the study was viewed as a means of locating water supplies that would require corrective action should epidemiologic studies show that low-level Ra ingestion was harmful to human beings. A total of 891 water supplies, in 20 states, serving 3,864,500 people was analyzed for Ra. Seventy-two were found to contain from 1 to 3 pCi/l, and 41 water supplies, serving 144,000 people in 10 states, contained 3 or more pCi/l. Four of the 41 water supplies, serving 3000 people, contained 10 pCi/l or more. The highest Ra level found was 24.1 pCi/l, in a supply serving 360 people. The remaining 778 samples contained less than 1 pCi/l. The locations of the water supplies having 3 or more pCi of Ra/l were shown on a map. (BBB)

2834 OSNOVY RADIATSIONNOI ZASHCHITY V RENTGENOLOGICHESKOI PRAKTIKE. (Radiation Protection in Roentgenological Practice). Stavitskii, R. V.; Vikturina, V. P. Moscow, Izdatel'stvo Meditsina, 1968. 108p.

In the diagnostic and therapeutic uses of x radiation, the personnel must be protected against the radiation, and the radiation dose to the patient must be limited to that necessary. Concrete recommendations are given for the physician on questions of radiation protection of patients and personnel. The protection of patients during roentgenological studies, radiation safety of personnel of roentgenological cabinets, and construction-design elements of protection against radiation in roentgenological cabinets are discussed. (J.S.R.)

2835 THE UNDESIRABLE SECONDARY RADIATION IN THE TREATMENT ROOM OF THE 42 MeV BETATRON OF SIEMENS. Rassow, Juergen; Strueter, Horst-Dieter; Lacin, Erol (Ruhr-Univ., Bochum, Ger.). Strahlentherapie, 136: 183-95(1968). (In German).

At the 42 MeV Betatron of Siemens, the radiation transmitted through the accessible parts of the irradiation head was measured. The highest dose rate was found to be, for all possible parameters of the irradiation, only $5‰$ of the beam, and at the level of the patient, $0.4‰$. The total secondary radiation from the phantom is superior, with a factor 10, to the transmitted radiation at 50 cm distance from the irradiated field. The part of the hard component (HVL about 17 mm Pb) amounts to 15 to 60% of the secondary radiation, according to distance of 25, 50, and 100 cm from the central axis, but 100% of the transmitted radiation. Further, the ambient doses in the treatment room are studied (for vertical and horizontal beams) with and without a phantom. All measurements were made with electrons and photons of 43 MeV peak energy. To allow calculations of the protective walls, the dose rates at 50 cm distance within the walls are given for the largest field, in function of the thickness of the phantom and for the different beam compensators. (auth)

2836 SOME COMMENTS ON A RECENT TRANSPORTATION INCIDENT. Karp, W. (Tracerlab. Inc., Waltham, Mass.). Health Phys., 15: 371(Oct. 1968).

Reference is made to some alleged serious deficiencies in dealing with a transportation incident which involved radioactive contamination of persons, vehicles and homes, together with steps to mitigate the deficiencies. (INIS) (U.K.)

2837 PROTECTION AGAINST THERMAL RADIATION. Ghosh, R. C.; Nanda, J. N. Labdev (Kanpur), 5: No. 1, 1-4 (1967).

The protection against the 20 kton A-bomb type was described. The characteristics of the nuclear flash, the effect of thermal radiation on textile materials, and its mechanism that is different from normal burning, the mechanism of transmission of heat through the clothing assembly and the principles of the designing of the protective clothing were discussed. Laboratory techniques to simulate high intensity thermal energy were described. The necessity of physiological evaluation of the protective garment for assessing the heat load on man was stressed. (Indian Sci. Abstr.)

2838 CONVENTION ON THIRD PARTY LIABILITY IN THE FIELD OF NUCLEAR ENERGY. Signed at Paris on 29th July 1960, with Additional Protocol, Signed at Paris on 28th January, 1964. Cmnd. 3755 (Superseding Cmnd. 1211 and 2356). Entered into Force 1 April 1968. Treaty Series No. 69 (1968). London, Her Majesty's Stationery Office, 1968. 156p. 12s. 6d. (In Several Languages).

2839 STUDY OF RADIATION LOADS IN ROENTGENOLOGICAL EXAMINATION OF THE CHEST BY DIRECT MEASUREMENT OF INTEGRAL ABSORBED DOSES. Shevchenko, I. T.; Yushchenko, N. G.; Burtan, N. N. (Kiev Scientific-Research Inst. of Roentgen-Radiology and Ocology). Vestn. Rentgenol. Radiol., No. 4, 68-75(July-Aug. 1968). (In Russian).

Radiation doses in roentgenological examinations of the chest were studied by direct measurement of integral absorbed doses with the aid of electrometric devices. Data of radiation doses in 569 persons subjected to examination were analyzed. Results

showed that radiation doses were strictly individualized. Mean radiation doses were proportional to the tension in the x-ray tube raised to the third to fourth power. (auth)

2840 MEASUREMENT OF DOSES OF ROENTGEN RADIATION WITH THE AID OF IFK-2.3M CASSETES. Kozlov, V. F.; Merkulova, V. S. Med. Radiol., 13: 77-80(Sept. 1968). (In Russian).

The technique of measuring x radiation doses within the energy range of 20 to 80 keV with the aid of cassetes with aluminum and lead filters replaced by copper ones 0.05, 0.2, and 0.5 mm thick is described. Such filters create an essential difference of the density of darkening under them even in low doses, thus facilitating the determination of the energy and dose of x radiation. (auth)

2841 MEASUREMENT OF INTEGRAL ABSORBED DOSES WITH THE USE OF A PARALLEL PLATE CHAMBER OF EXTRAPOLATION TYPE. Pospelova, N. I. (Central Scientific Research Inst. of Roentgen-Radiology, Moscow). Med. Radiol., 10: No. 13, 59-63(1968). (In Russian).

An experimental method is described for the measurement of integral absorbed doses of γ and x radiations both within the boundaries of the primary radiation beam and on the outside in the region of scattered radiation. A device consisting of a parallel plate ionization chamber of extrapolation type with a zonal collecting electrode and a tube electrometer was tested in phantoms. The measurements presented were carried out with the use of a gamma unit and a linear accelerator with a maximum bremsstrahlung 4.3 MeV, the exposure field being 16 cm^2 and 100 cm^2. (auth)

2842 THE WORK OF INTERNATIONAL ORGANIZATIONS IN THE FIELD OF RADIOLOGY. Jaeger, Robert G. Roentgenpraxis, 20: 126-34(June 1967). (In German).

Agencies of the United Nations were concerned with preparation of a three volume standard atlas of radiation dose distributions, that presented isodose diagrams for single fields, multiple fields, and moving irradiation fields. Effects of physical and geometric factors on dose distribution were discussed for a homogeneous H_2O equivalent medium. The third volume of properties of compounds of ^{14}C, ^{3}H, ^{125}I, ^{131}I, ^{32}P, and ^{35}S, was published. Other volumes published by other international agencies included reports on the use of radioisotopes and supervoltage radiation in radiotele therapy, toxicity of radionuclides, safe handling of radioisotopes, removal of radioactive fallout, basic safety standards, and norms of radioprotection. Other related subjects that were discussed in various publications included use of the whole-body counter, increases in environmental irradiation due to increased and more widespread use of radioisotopes, establishment of basic standards and values for measurement of radioisotope concentrations and doses, dosimetry of x irradiation, accuracy and reproducibility of standards, and equivalent and absorbed irradiation doses. The availability and sources of the various publications mentioned were indicated. (BBB)

2843 VISUAL RECOVERY FROM BRIEF EXPOSURES TO HIGH LUMINANCE. Miller, Norma D. (Ohio State Univ., Columbus). J. Opt. Soc. Amer., 55: 1661-9(Dec. 1965).

Experiments were conducted apropos to the design of protective devices for individuals who might need to perform critical visual tasks after exposure to sudden flashes of light from the detonation of nuclear weapons or from other high energy sources. To ensure that an individual could recognize the pertinent detail in a visual display within a few seconds following a flash, data were needed on the time delay that could be tolerated in actuating the protective device for any anticipated flash luminance. Data were also needed for estimating the illuminance required for the display in order that the minimum size of detail could be recognized through the afterimage, within the allowable period following the flash. The Maxwellian-view optical system described provided a circular flash field of 10° diam, and at the peak of the flash, the field luminance was 5.4×10^5 L. A rotating-mirror shutter system permitted flash durations of 1.4 to 0.64 msec with constant pulse shapes for all durations. The maximum flash energy was 4×10^7 td-sec or 0.042 cal/cm^2 at the retina, neglecting losses in the ocular media. The criterion measure for visual performance following the flashes was the identification of Sloan-Snellen letters of different sizes. Some variables studied were the size of the flash field and the duration of the flash. The time course of recovery following various flash energies was investigated by varying the letter size and the letter luminances. A linear relation was found between the logarithm of retinal illuminance times the duration of the flashes and the logarithm of the recovery times for the recognition of a 20/60 acuity target at 0.07 mL, over the range of 20- to 130-sec recovery time, corresponding to a range of 9×10^5 to 3.0×10^7 td-sec flashes. There was no significant cumulative effect on recovery times with successive flashes after the second flash when they were presented at intervals of three or four min. (BBB)

2844 THE CONTAMINATION OF RADIOIODINE IN MILK CAUSED BY NUCLEAR BOMB TESTS BY RED CHINA. Mitsuhashi, Toshihiko; Danbara, Hirohsi (National Inst. of Animal Industries, Japan). Eiyo to Shokuryo, 20: No. 4, 68-70(Nov. 1967). (In Japanese).

The concentration of ^{131}I in milk in Japan was determined daily after explosion of five nuclear bomb tests by Red China. The contamination of milk by ^{131}I was detected very clearly and rapidly. The maximum concentration of ^{131}I in milk in Chiba Province was elevated to 400 pCi/l following the first test, and the radioactive contamination continued about one month. In the cases of the second to the fifth tests, the increase of ^{131}I in milk was relatively low, and the activity disappeared within 7 to 10 days after each explosion. (auth)

2845 RESEARCH ON RADIOCONTAMINATION TRANSPORT IN FOOD CHAINS: ^{90}Sr IN PARMIGIANO–REGGIANO CHEESE DURING 1957 TO 1963. Cigna, A.; Mariani, A.; Spadoni, M. A.; Tomassi, G. (Istituto Nazionale della Nutrizione, Rome. CNEN, Rome). Quad. Nutri. 27: 171-8(1967). (In Italian). (RT/PROT–(67)19).

Strontium-90 content in samples of parmigiano-reggiano produced between 1957 to 1963 in the area of Reggio Emilia was measured. Strontium-90 and Ca distribution in the different steps of parmigiano-reggiano manufacturing (milk, whey, curd, before and after salting) and the U. S. milk/grass ratio were also studied. The results showed a low and quite uniform level of U. S. in the samples of parmigiano-reggiano analyzed. Approximately 70% of ^{90}Sr and Ca was found in the curd. The U. S. milk/U. S. grass ratio was markedly lower than the values reported by other authors. This difference was related to the feeding of the milk-cows in the region where parmigiano-reggiano is produced. (auth)

2846 RADIATION DOSE AND IONISATION FROM RADIOACTIVE FALLOUT. Gibson, J. A. B.; Peirson, D. H. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London), 220: 464-6(Nov. 2, 1968).

A comparison was made between the radiation dose rate and ionisation arising from artificial and natural sources, using measurements made at a single locality (Grove, Berkshire). Continuous measurements were made of the γ and β radiation over open grassland since 1961. The cosmic radiation and the internal background rate of the detector were derived by making measurements over water and in lead shields to remove terrestrial radiation, and the mean value of the dose rate from cosmic radiation at 1m was found to be 3.4 μ rads/hr, excluding neutrons, corresponding to an ionisation at 50 cm. of 2.2 ion pairs/cm^3/sec(I). The natural radioactivity of dry soil was measured by gamma ray spectrometry, and the dose rates and ionisation above the soil from β and γ radiation were calculated. The dose rates and ionisation from β and γ radiation were small compared with cosmic radiation and soil radioactivity. Ionisation attributable to α-radiation was more significant. From the data obtained the net radiation dose rates resulting from deposited fallout since 1961 were calculated, and the curves were extended back to 1951 by using data from nearby locations. Maxima in radiation from fallout were found corresponding to the nuclear explosions of 1958, 1961, and 1962. The peak value of 3.6 μ rad/hr. (2.7I) from γ radiation was smaller than the average natural penetrating radiation (γ and cosmic) value of 7.1 μ rad/hr. (4.6I); the corresponding peak value for β radiation of 40 μ rad/hr (36I) compared with the natural background of 1.4 μ rad/hr β and 3.0I(β and α). The estimates may be translated to other locations by allowing for barometric pressure, rainfall, latitude, and radioactive content of the ground. Electrical effects in air due to β radiation have also been observed. (U.K.)

2847 VARIATION OF BETA DOSE ATTENUATION IN DIFFERENT MEDIA. Cross, William G. (Chalk River Nuclear Labs., Ont.). Phys. Med. Biol., 13: 611-18(Oct. 1968).

The dose distribution around a point source of β particles in any homogeneous low-Z medium is related to that in air by a distance scaling factor and a closely related renormalization factor. A simple method is described for calculating this scaling factor (or relative attenuation), that is given approximately by the expression $0.818(1 + 0.0284\ \bar{Z})\ (S/S_{air})$, where S is the stopping power and $\bar{Z}$ is an effective value of Z for the medium. The values of relative attenuation obtained agree to within 1.5% with those calculated from Spencer's theory, or measured in aluminium, polystyrene, and ethane, and to within 2% with those measured in argon. A similar linear expression, with a slope 2% smaller, gives agreement with values of relative attenuation measured for $13 < \bar{Z} < 80$. (auth)

2848 COMPUTER SYSTEM FOR INTERSTITIAL AND INTRACAVITARY DOSE CALCULATIONS. Jameson, D. G.; Campion, Jean M.; Trevelyan, Ann (Middlesex Hospital Medical School, London). Brit. J. Radiol., 41: 696-700(Sept. 1968).

A system using an Elliott 803 computer with magnetic film backing store was designed to perform calculations in three dimensions in intracavitary and interstitial radiation dosimetry. This system was developed from the experience gained in using another program for three years. The system is in modular form; each individual program performs a different stage of the calculation. These programs are stored on the magnetic film and are so arranged that they can be altered or replaced without having to rewrite the whole system. Programs are included to carry out calculations for point sources, line sources, and linear filtered sources. The system was designed either to carry out simple routine calculations or to incorporate various correction factors. The system also provides facilities to plan the supplementary external beam treatment for patients who have already had intracavitary treatment. (auth)

2849 ^{210}Pb IN NEW ZEALAND MILK. Baltakmens, T. (New Zealand Dept. of Health, Christchurch). Aust. J. Sci., 31: 111-14(Sept. 1968).

Milk ash samples were analyzed for ^{210}Pb to test the hypothesis that this isotope is produced in nuclear explosions. The results showed large differences between maximum and minimum values with a simultaneous increase and decrease in samples from all parts of New Zealand. It was suggested that at least the significant variations in ^{210}Pb content are due to changes in fallout. (C.O.)

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Refer also to abstracts 2534, 2560, 2625, 2740, 2749, 2753, 2761, 2763, 2774, 2834, 2837, 2843, 2848, 2921, 2922, 2961, 2968, 2969, 2977, and 2989.

2850 (LA-tr-68-10) THE EFFECT OF FERRICYANOFERRATE (II) ON THE BEHAVIOR OF RADIOCESIUM IN GRAVID AND LACTATING RATS. Havlicek, F. Translated for Los Alamos Scientific Lab., N. Mex., from Stud. Biophys., 2: 239-46 (1967). 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Oral administration of ferricyanoferrate (II) shortened the retention time of ^{137}Cs in unmated, pregnant, and lactating rats. The uptake of ^{137}Cs by embryos and newborn animals was accordingly reduced. (auth)

2851 (NYO-910-71) BIOLOGICAL EFFECTS OF RADIATION AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. PROPOSAL NO. 3. METABOLIC STUDIES IN CANCER WITH RADIOACTIVE ISOTOPES. Progress Report, May 1, 1967-May 1, 1968. Laughlin, John S.; Myers, W. P. Laird (Sloan-Kettering Inst. for Cancer Research, New York). Sept. 30, 1968. Contract AT(30-1)-910. 38p. Dep. CFSTI.

Several hundred scans of various organs, including bone, bone marrow, brain, liver, parathyroid, and spleen were processed. A detailed comparison of the diagnostic quality of quantitative computer-analyzed brain scans and simultaneously recorded high quality photoscans was carried out and reported. A digital Anger Camera was constructed to permit quantitative stationary imaging of nuclide distributions in vivo for both single gamma emitters and positron emitters; tests indicate that this system will have the advantages of large area aperture without significant distortion, together with good spectral and spatial resolution. Experimental procedures were developed for evaluation and intercomparison of moving scanners, collimated scintillation camera, and uncollimated positron camera. Digital computing techniques were applied to the determination of the gamma ray point source response function for a number of crystal focusing collimator combinations. Good agreement was obtained between theoretical results and experimental measurements of the response of a tungsten focusing collimator to 1.3 MeV gamma rays. Total body computer-analyzed scans were performed on patients injected with ^{99}Tc-labeled sulfide colloid, ^{59}Fe-labeled ferrous citrate, and ^{52}Fe-labeled sodium citrate. Results indicated that sites of phagocytosis and erythropoiesis were adequately visualized, and that the technique could be used for diagnosis of questionable leukemias. A program in regional pulmonary evaluation involved the development of specifications for scintillation detectors and data processing apparatus. The evaluation of ^{123}I in thyroid function tests involved the production of this isotope as well as that of ^{121}I and ^{124}I by the CS-15 cyclotron. A comparison of quantitative, computer-analyzed scanning with photoscanning for the detection of brain lesions revealed that the quantitative scan was more accurate than the photoscan. Metabolic and scanning studies were conducted on patients with bone and parathyroid disease using ^{47}Ca, ^{18}F, ^{131}I, and ^{85}Sr. Selenium-75-labeled selenomethionine was used in studies on parathyroid metabolism and thyroid suppression. (H.L.W.)

2852 (RISO-M-766) KIDNEY RENOGRAM TEST SIMULATION ON ANALOGUE OR DIGITAL COMPUTER. Hoejberg, K. Soee (Danish Atomic Energy Commission, Risoe. Research Establishment). June 1968. 17p. (R-20-68). Dep.

A simplified mathematical model of the kidney and the external system dynamics in connection with the radiohippuran renogram test is presented. Renogram test simulation is carried out by means of a relatively simple analog computer circuit. An equivalent simulation is realized on a small digital computer PDP 8 with interface equipment used for recording. (Denmark)

2853 (TT-67-56003/1) POLISH REVIEW OF RADIOLOGY AND NUCLEAR MEDICINE. Translation of Pol. Przegl. Radiol. Med. Nukl., 31: 1-166(1967). 163p. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2854 (TT-67-56003/3) POLISH REVIEW OF RADIOLOGY AND NUCLEAR MEDICINE. Translation of Pol. Przegl. Radiol. Med. Nukl., 31: 321-475(1967). 151p. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2855 (TT-68-50006/1) POLISH MEDICAL JOURNAL, 7: 1-254(1968). Translated for National Library of Medicine, Washington, D. C., from selected Polish medical publications. 254p. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2856 (UCLA-12-687) SCINTISCANNING AND ROENTGENOGRAPHIC PROCEDURES IN MANAGING MAJOR PULMONARY DISORDERS. Taplin, G. V.; Poe, N. D.; Dore, E. K.; Swanson, L. A.; Isawa, T.; Greenberg, A. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology. Los Angeles County Harbor General Hospital, Torrance, Calif. Nuclear Medicine Div. Olive View Hospital, Calif. Dept. of Radiology. Memorial Hospital, Long Beach, Calif. Dept. of Nuclear Medicine). June 10, 1968. Contract AT-04-1-GEN-12. 33p. (CONF-680804-1; SM-108/116). Dep. CFSTI.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria.

Current applications of two types of lung scintiscanning procedures as useful adjuncts to chest roentgenography and pulmonary function testing in the management of pulmonary embolism, tuberculosis, chronic obstructive bronchopulmonary disease, and bronchogenic carcinoma are described. Results of five years experience in scanning nearly 4,000 patients are condensed by presenting representative case studies in each category, that illustrate the additional information provided by chest scintiscanning, when performed in conjunction with roentgenography and pulmonary function measurements and interpreted in the light of clinical findings and pertinent laboratory data. During the first four years, perfusion scans were performed following the intravenous injection of 200 to 300 μc of ^{131}I-labeled albumin macroaggregates. In the past year ^{99m}Tc-labeled albumin macroaggregates were used for the same purpose in doses of 600 to 1200 μc. Initially, radioaerosol inhalation scans were performed using nebulized colloidal gold labeled with ^{198}Au. For the last two years ^{99m}Tc-labeled albumin was used for this purpose almost exclusively. In most of the studies, conventional rectilinear scanners with either three or five inch diameter sodium iodide crystals and coarse collimators were employed (7 and 19 holes respectively). During the past two years a ten probe rectilinear scanner was employed using a coarse collimator with five inch focus and $^{5}/_{8}$ inch resolution at the focal plane. The frequent diagnostic problems encountered in suspected pulmonary embolism are emphasized and the value of combined inhalation-perfusion scanning procedures is stressed. Finally, the limitations of current chest scanning procedures and test agents are described along with ways they may be minimized by using rapid imaging devices and short-lived isotopes now becoming more readily available. (auth) (TSS)

2857 NATURE OF THE MEMBRANE INJURY IN IRRADIATED HUMAN ERYTHROCYTES. Shapiro, Bernard; Kollmann, George (Albert Einstein Medical Center, Philadelphia). Radiat. Res., 34: 335-46(1968).

The mechanism of the radiation-induced increase in sodium accumulation of erythrocytes was studied by chemically altering the cell surface and the cell interior. Agents such as p-chloromercuribenzene sulfonate (PCMBS) and bis(2-guanidoethyl)disulfide (GED), which block surface sulfhydryl groups, mimicked the radiation effect but, when employed with γ radiation, reduced the

radiation effect. Papain, which increased the surface sulfhydryl groups, increased the radiation effect. Trypsin and neuraminidase, which did not alter surface sulfhydryl groups, did not alter the radiation effect. Agents that altered the heme (nitrite, carbon monoxide, nitrogen) or globin (CrO_4^{2-}) of hemoglobin inside the cells did not alter the radiation effect. The measurement of sulfhydryl groups on the cells showed decrease on irradiation. Reversal of PCMBS effect on sodium accumulation was observed with glutathione and 2-mercaptoethylguanidine and correlated with the removal by these agents of a small amount of the PCMBS from the cells. Reversal of radiation effect on sodium accumulation was observed with dimenoptopropanol (BAL). Radiation increased accumulation of other monovalent cations besides Na but did not affect accumulation of divalent cations, anions, or nonionic substances. The results indicate that the sulfhydryl group is the major target in radiation alteration of erythrocyte Na-K permeability, that alteration of only a small number of sulfhydryl groups on the cell surface creates most of the effect, and that the result is not the production of a membrane hole but the induction of a very specific chemical change in the membrane affecting only monovalent cation permeability. (auth)

2858 ANTIRADIATION COMPOUNDS. XII. DITHIOCARBAMATES OF STRONGLY BASIC ACRIDINES AND QUINALDINES. Foye, William O.; Kay, Douglas H.; Amin, Pramod R. (Massachusetts Coll. of Pharmacy, Boston). J. Pharm. Sci., 57: 1793-6(Oct. 1968).

Dithiocarbamates of strong heterocyclic bases (pKa 8-12) in the acridine and quinaldine series have been obtained, with further examples of the formation of imino-N-carbodithioates. Significant radiation protection of mice was found for the dithiocarbamate ester of 9-aminoacridine, whereas dithiocarbamates of both stronger and weaker bases were nonprotective. (auth)

2859 SYNTHESIS AND PRELIMINARY EVALUATION OF A NEW QUINUCLIDINE DERIVATIVE AS A RADIOPROTECTIVE AGENT. Shapiro, Warren; Tansy, Martin F.; Elkin, Samuel (Temple Univ., Philadelphia). J. Pharm. Sci., 57: 1725-8(Oct. 1968).

7,10-Ethano-1-thia-4,7-diazaspiro [4,5] decane dihydrochloride was prepared by the condensation of 3-quinuclidone by hydrochloride with 2-aminoethanethiol hydrochloride. The compound was shown to have potential radioprotective properties against a lethal dose of x radiation in mice. Optimum protection was obtained in a group of mice pretreated intraperitoneally with 0.20 mg/g of 7,10-ethano-1-thia-4,7-diazaspiro [4.5] decane dihydrochloride 15 min prior to exposure, where 58.3 percent survived. A toxicity study showed the i.p. LD_{50} of the compound to be 295 mg/kg with a dose range of 257-339 mg/kg ($p < 0.05$). (auth)

2860 CARDIAC CATHETERIZATION USING A RADIOACTIVE CATHETER AND THE SCINTILLATION CAMERA. Van Dyke, D.; Anger, H.; Duffie, E. Jr.; Higashino, S.; Wilson, J. (Univ. of California, Berkeley). Radiology, 91: 749-52(Oct. 1968).

The speed and resolution of the scintillation camera are such that the course and movements of a catheter labeled with a gamma-emitter (^{141}Ce) can readily be seen on the camera's oscilloscope screen. By projecting this image on a roentgenogram of the patient's chest, one can visualize the passage of the catheter through the vascular channels of the heart in the same way that a radiopaque catheter is seen under fluoroscopy. Anatomic information is provided by a single roentgenogram of the chest, resulting in a significant reduction in radiation dose to the patient. On the basis of a limited comparison of the scintillation camera technic with routine fluoroscopic procedure, it was concluded that placement of the catheter by the new method presented no difficulty when properly labeled catheters of the right size were available. (auth)

2861 THE SIGNIFICANCE IN THE DIAGNOSIS OF THYROID DISEASES OF THE IODIDE AND THYROXINE PHASES OF THE RADIOIODINE 2-PHASE THYROID FUNCTION TEST. Zeidler, U. (Medizinische Hochschule, Hanover). Nucl.-Med., 7: 148-64(Aug. 30, 1968). (In German).

Using statistical methods, it is demonstrated that the radioiodine 2-phase thyroid function test of Horst allows, by means of a simple measurement of the iodine uptake by the thyroid, a clear-cut separation between hypothyroidism and euthyroidism. In the differential diagnosis between hyperthyroidism and euthyroidism measurements during the so-called iodide phase are without value since the two-sigma ranges of both groups overlap considerably. Differentiation by a single measurement which determines uptake only, such as, for example, in the 24-hour uptake test commonly used in the USA, is impossible at any time after administration. On the other hand, a constant finding in untreated hyperthyroidism is the increase in intrathyroidal turnover which is characterized by the following findings: decrease of the thyroid radioactivity after reaching a peak, renewed increase of the radioactivity in the liver and increased protein-bound ^{131}I. These effects are caused by the same mechanism: faster release of labeled hormones or their analogues is equivalent to reduced intrathyroidal retention of the accumulated radioactive iodide. The parameters so determined can therefore be exchanged with each other. Determination of all of them serves mutual control purposes. Because of its good reproducibility and its small overlap the determination of the protein-bound ^{131}I is of the greatest value. The time needed for the thyroid function test can therefore be reduced without loss of information. Measurements at 2 and 6 to 8 hours after administration of the dose can be dispensed with. Preliminary studies indicate that the 48-hour measurement can be replaced by a 32 to 36-hour measurement so that the time needed for the test can be reduced from three to two days. (auth)

2862 SCINTIGRAPHIC DETECTION OF MALIGNANT TUMORS WITH $^{197}HgCl_2$. Isaac, R.; Raynaud, C.; Kellershohn, C. (Commissariat a l'Energie Atomique, Orsay, France). Nucl.-Med., 7: 97-106(Aug. 30, 1968). (In French).

The uptake of mercury after intravenous injection of 1500 μCi of $^{197}HgCl_2$ was studied in 89 patients with malignant or benign tumors or with inflammatory lesions. Tumor uptake is relatively high at 24 hr and still at 48 hr whereas in benign tumors and in inflammatory lesions it is practically negligible at 48 hr though significant at 24 hr. The technique is sufficiently reliable and accurate to allow its use as a routine method in the regions of the lungs, the neck and the face. (auth)

2863 EFFECTS OF CYSTAMINE ON NUCLEAR CHANGES IN THE KIDNEY FOLLOWING IRRADIATION. Smoliar, V. (Univ., Liege. Institut Interuniversitaire des Sciences Nucleares, Liege). Compt. Rend. Soc. Biol., 162: No. 1, 296-8(July 12, 1968). (In French).

By x-irradiation of rats aged two months, whose kidneys are in slow but constant growth, the development of lesions was studied in physiological conditions and the extent to which they are influenced by the administration of a chemical radioprotector before irradiation was determined. The rats were exposed to whole-body irradiation of 700 R. Some of the animals received an intraperitoneal injection of cystamine chlorohydrate 10 min before irradiation and the others were injected intravenously 1 hr before irradiation with isogenic hematopoietic bone marrow. The animals were sacrificed 1 hr and 1, 2, 3, 5, and 6 weeks after the irradiation. The results showed that the absolute mitotic blockage observed one hour after irradiation does not persist and that the percentage of cells in mitosis of the irradiated animals is not inferior to that of the controls. (J.S.R.)

2864 CLINICAL PROCEDURES WITH THE ^{99m}Tc-IRON COMPLEX IN RENAL SCINTIGRAPHY: A COMPARISON WITH MERCURY PREPARATIONS. Hennig, K.; Woller, P.; Knoll, P. (Nuklearmedizinische Abteilung der Radiologische Klinik, Dresden. Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed., 109: 366-74(Sept. 1968). (In German).

Technetium-99m-iron complex produced the lowest radiation dose to the kidneys of all the radioactive substances used for renal scintigraphy. We calculate this as approximately 550 mrad per mCi. The suitability of the technetium-iron complex for renal scintigraphy was tested on 100 patients and the results compared with those of ^{203}Hg-hydroxymersalyl and ^{197}Hg-neohydrin. The renal scintigrams obtained with the technetium-iron complex proved at least as satisfactory as those with neohydrin or hydroxymersalyl. Particular attention should be paid to the timing of the scintigram. Our experience has shown that the technetium-iron complex is the substance of choice for renal scintigraphy; its method of preparation is described. (auth)

2865 DITHIOTREITOL: A NEW RADIOPROTECTOR. Falconi, C.; Scotto, P.; de Franciscis, P. (Univ., Naples). Boll. Soc. Ital. Biol. Sper., 44: 326-8(Feb. 28, 1968). (In Italian).

The radioprotective effects of dithiotreitol (DTT, Calbiochem) were compared with cysteamine and AET. Mice were injected 15 min before irradiation with the reduced and oxidized forms of DTT, cysteamine, or AET. The mice were exposed to lethal x ray doses and the efficiency was measured as a function of survival after 30 days. The results showed that the oxidized DTT, at a dose of 5 mg, had a significant radioprotective effect (56% survival), whereas the reduced DTT had a smaller effect (30% survival). Smaller doses of DTT did not have a protective effect. (J.S.R.)

2866 SCANNING OF THE VERTEBRAL CANAL: A NEW TECHNIQUE USING THE INTRAVENOUS INJECTION OF ^{99m}Tc. Fazio, C.; Agnoli, A.; Bava, G. L.; Bozzao, L.; Fieschi, C.

(Univ., Genoa). Minerva Med., 59: 3459-65(Aug. 25, 1968). (In Italian).

A new technique for scanning the vertebral canal is presented. By analogy with cerebral scintiscanning, the technique consists of the evaluation of radioactivity in the vertebral canal after the intravenous injection of a tracer. Positive results following the use of the technique in five cases of vertebral or vertebromedullary lesion are reported. In a single case of intramedullary tumor, however, the technique failed to demonstrate the presence of the lesion. (auth)

2867 THE USE OF ^{85}Sr IN THE DIAGNOSIS OF BONY METASTASES. Robillard, J.; Couette, J.-E.; Bloquel, J.; Cheguillaume, J.; Malinowski, A. Ann. Radiol., 11: 507-13 (1968). (In French).

Strontium-85 scanning is often decisive, especially in the detection of bony metastases. Results are reported from scans in 103 patients, 78 of whom had metastases. The scans were made 48 hours after an intravenous injection of 150 to 200 μCi of ^{85}Sr. The indications for the use of ^{85}Sr scans are essentially to search for other deposits from an already known bony lesion, to confirm the presence or absence of a lesion suspected on x-ray pictures, to confirm the presence of a metastasis suspected clinically when the x-ray picture is normal, for rapid skeletal surveys in infirm patients who are difficult to radiograph, and to follow the evolution of a metastasis under treatment. (auth) (TSS)

2868 INFLUENCE OF HYDROXYUREA, ELLMAN'S REAGENT AND POTASSIUM FERRICYANIDE ON THE RADIOSENSITIVITY OF ESCHERICHIA COLI. Moroson, H.; Tenney, D. (Sloan-Kettering Inst., Rye, N. Y.). Experientia, 24: 1041-2 (Oct. 15, 1968).

Two thiol binding agents, potassium ferricyanide and Ellman's reagent, and hydroxyurea were investigated under aerobic and anoxic conditions as possible x-radiosensitizing agents for bacteria. It was found that hydroxyurea and potassium ferricyanide were effective sensitizers under anoxic conditions. (tr-auth)

2869 ^{198}Au LIVER SCANNING IN HEPATIC AMEBIC DISEASE. Otero, Efraim (Instituto Nacional de Cancerologia, Bogota). J. Nucl. Med., 9: 406-11(July 1968).

Liver scanning revealed the presence of amebic abscesses in 33 patients, 29 of which were anatomically confirmed. Because there were no false negatives in this group, the diagnostic accuracy of the method could be considered close to 100%. In seven patients out of 13 who exhibited scan pictures of normal livers, clinical symptoms and signs of hepatic amebic disease were present but had subsided rapidly after early medical treatment; doubt persisted as to whether these were cases with small undetected abscesses or with diffuse amebic hepatitis. Follow-up scans in 10 patients with space-occupying lesions revealed that liver recovery took place rapidly after treatment, but that the space-occupying lesion may persist for up to 5 months, depending on its initial size and on the type of treatment (medical, surgical, or combined) used. (auth)

2870 EFFECT OF NORADRENALINE ON RADIATION INJURY OF PROLIFERATIVE PILARY FOLLICLES. Letov, V. N. (Inst. of Experimental and Clinical Oncology, Moscow). Vop. Onkol., 14: No. 8, 63-6(1968). (In Russian).

Preliminary application of noradrenaline solution to irradiated mouse skin reduced radioactive reaction of the follicles as much as 1.5 to 2 times. A pronounced protective effect of skin anemization against radiation injuries of pilary follicles of the order of 1.5 to 2 times was found with the help of a method of total preparations in doses up to 1000 R for a single irradiation and up to 400 R in a combined medical and radiation treatment. (auth)

2871 SODIUM SELENITE ^{75}Se. A MORE SPECIFIC AGENT FOR SCANNING TUMORS. Cavalieri, Ralph R.; Scott, Kenneth G. (Univ. of California, San Francisco). J. Amer. Med. Ass., 206: 591-5(Oct. 14, 1968).

Brain scanning, with any of several radioactive pharmaceutical agents, permits the accurate localization of intracranial lesions. Bone scanning, with radioactive strontium, allows the detection of localized disease of the skeleton. However, none of the agents in current use is specific for tumors. In an attempt to improve the diagnostic accuracy of radioisotope scanning, the usefulness of a new agent, selenite, ^{75}Se, has been studied in patients with intracranial disease and in cases of localized lesions of bone. Compared with conventional brain-scanning agents, selenite was equally effective in detecting intracranial tumors and yielded fewer abnormal scans in cases of cerebrovascular disease. In the patients with bone lesions, localization of selenite occurred in tumors and uniformly normal scans were obtained in non-neoplastic disease. Because of its relative specificity for tumors, selenite is of value, particularly when used in combination with conventional scanning agents, in the diagnosis of tumors of brain and bone. (auth)

2872 URINARY BLADDER OPACIFICATION FOLLOWING LYMPHANGIOGRAPHY. Wendth, Arthur J. Jr.; Moriarty, Daniel J.; Cross, Valmore F.; Vitale, Peter (St. Peter's Hospital, Albany, N. Y.). Radiology, 91: 762-3(Oct. 1968).

A case report is presented in which the finding of an opacified urinary bladder was noted after the intralymphatic injection of ^{131}I-labeled-Ethiodol. A superficial comparison is made between this finding and the laboratory animal studies of Koehler. The potential hazards to the urinary tract by intralymphatic administration of therapeutic doses of isotopes are re-emphasized. (auth)

2873 DECREASE IN THE ULTRASOUND RESISTANCE OF THROMBOCYTES FOLLOWING WHOLE BODY IRRADIATION: INFLUENCE OF 1-METHIONINE ON THE CHANGE IN RESISTANCE. Gazso, Jozsef; Nagy, Janos; Gyorgyi, Sandor (Medical Univ. of Budapest). Kiserl. Orvostud., 19: 470-2(Oct. 1967). (In Hungarian).

The ultrasound resistance values of thrombocytes were determined 1, 2, 24, and 48 hours after the irradiation of animals using 1000, 500, 200, or 100 rad doses, with or without pre-treatment with 1-methionine. A larger percentage of the thrombocytes died in response to the ultrasound in irradiated animals that did not receive methionine than in those treated with methionine. The protective effect of methionine was significant and was found to be practically identical when administered for seven days or in a single instance before irradiation. (JPRS)

2874 TUMORS IN RATS TREATED WITH PENTACIN AFTER INJECTION OF ^{239}Pu. Bukhtoyarova, E. M.; Lemberg, V. K.; Erokhin, R. A.; Belyaev, Yu. A. Vop. Onkol., 14: No. 8, 71-6 (1968). (In Russian).

Three two-week cycles of pentacin injections with a 14 day interval between them (in a dose of 40 mg per rat intraperitoneally once a day) in rats previously injected with plutonium nitrate in the optimum blastomogenic dose (2 μ/Kg) reduced the plutonium content in the skeleton and liver, prolonged the survival of animals and decreased the rate of bone tumor incidence. The injections of pentacin started a day after plutonium injection, proved to be most effective. The incidence of bone tumors was reduced from 19.3 per cent to 5.2 per cent. In treatment started in a month osteosarcomas developed in 8.2 per cent. The treatment initiated a year following the plutonium injection decreased insignificantly the isotope content in the skeleton, but did not reduce the total incidence of osteosarcomas. The therapy undertaken a day after the isotope injection prolonged the latent period of development of soft tissue tumors, but did not change their frequency. The use of pentacin after a month significantly increased the incidence of soft tissue tumors. (auth)

2875 HEMOPOIESIS STIMULATION IN THE CASE OF LEUKOPENIA INDUCED BY EXPOSURE TO IRRADIATION. Randova, L. I. (Dnepropetrovsk Regional Oncological Hospital, USSR). Med. Radiol., 13: 70-1(Oct. 10, 1968). (In Russian).

Intramuscular introduction of banked blood produced an excellent stimulating effect on leukopoiesis in patients suffering from radioinduced leukopenia. The simplicity of the method and the excellent hemostimulating effects make it appropriate in all oncological installations. (tr-auth)

2876 FLUX DENSITY DISTRIBUTIONS IN AND AROUND A MAN-SIZED PHANTOM IRRADIATED WITH THERMAL NEUTRONS. Boot, S. J.; Dennis, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Med. Biol., 13: 573-83 (Oct. 1968).

Using a broad beam of thermal neutrons from the graphite column of a nuclear reactor, the presence of the phantom was shown experimentally to produce a disturbance of flux density levels over distances as large as 70 to 100 cm from its surface. From the experimentally determined flux density levels inside the phantom, the level of flux density equivalent to 2.5 mrem hr^{-1} was derived as 915 n cm^{-2} sec^{-1} when gonads and red bone-marrow were considered to be the critical organs. This was greater than the recommended level of 670 n cm^{-2} sec^{-1}, that may, therefore, be needlessly restrictive. The significance of the results for the calibration of instruments and dosemeters is discussed briefly. (auth) (UK)

2877 STUDIES IN QUANTITATIVE AUTORADIOGRAPHY WITH PARTICULAR CONSIDERATION OF SPECIAL EVALUATION TECHNIQUES. II. Herrmann, W.; Hartmann, G.; Baumbach, H. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Atompraxis, 14: 415-20(Sept.-Oct. 1968). (In German).

Questions of evaluation and two-dimensional presentation of the results of quantitative autoradiography are discussed. A simple chemo-photographic evaluation procedure is listed, and its effectiveness compared with that of other techniques. (auth)

2878 EXPERIMENTS ON PROBLEMS OF RADIOLOGIC-CYTOSTATIC COMBINATION TREATMENT. PART 4. SYN-CARCINOSTATIC INVESTIGATIONS WITH ENDOXAN ON CROCKER-SARCOMA 180 OF MICE. Ringleb, Dietrich; Grundner, Hans-Georg (Justus-Liebig-Univ., Giessen, Ger.). Strahlentherapie, 136: 320-35(Sept. 1968). (In German).

The effect of combined fractionated x irradiation and Endoxan therapy upon the testes of mice and upon the growth rate of the tails of infantile mice was investigated. Furthermore, the influence of an Endoxan therapy after x irradiation upon wound healing was studied in a punched mouse ear and the course of the radiation reaction was studied in a mouse tail that had received a necrotizing radiation dose. Syncytostatic effects were observed in germinative, infantile, and granulative proliferations of tissues. The injuries to vascular connective tissue systems showed also a cumulative effect. The course of the radiation reaction showed a temporal delay when Endoxan was administered after irradiation. In the case of simultaneously administered fractionated X ray and Endoxan therapy of mouse sarcoma-180, an antagonistic effect between both agents was observed when cure rate was used as a criterium. The results obtained are discussed in regard to their clinical use. (auth)

2879 RADIOISOTOPIC COLOR SCANNING OF PULMONARY AEROEMBOLI IN EXPERIMENTAL DECOMPRESSION SICKNESS: DYSBARISM. Cockett, A. T. K.; Mangelson, N. L.; Kado, R. T.; Nakamura, R. M.; Rhodes, D. B.; Swanson, L. (Univ. of California, Los Angeles). Aerosp. Med., 39: 1052-4(Oct. 1968).

A lethal overcompression-decompression model for dogs is presented. A modified diagnostic technique for decompression sickness that employs ^{131}I macroaggregates of serum albumin for color scanning of the lungs is described. Examples of color scans from three groups are presented. The pathologic physiology is discussed briefly. Complete recovery in the treated groups is seen if dextran infusion is not delayed or withheld beyond three to four hours after decompression. (auth)

2880 EXPERIMENTAL RESEARCH WITH IRRADIAN, AFTER SZIRMAI, A DRUG PROTECTING FROM IRRADIATIONS [ANIMAL]. Szirmai, E. A. (Coll. of Medicine and Surgery, Des Moines); Berkarda, B.; Hajdukovic, S.; Lopez-Gonzalez, J. M. Acta Oncol., 5: 245-52(1966). (In Spanish).

Irradian had a protective effect against x radiation in rats. Studies on the pharmacological effects showed that irradian had an insignificant toxicity. In the animal experimentation a remarkable antiflogistic and coloretic property, also a curative action suitable in the treatment of the experimental wound was noted. The action on the blood pressure was of secondary importance. The Irradian had no diuretic action. The spalmolitic action was higher than that of the papaverine. It had an atropinic action that was thirty times smaller than atropine. It had no midriatic effect. The antihistaminic action was weak in comparison with other antihistaminic compounds, however it was evident in the experimental animals. Irradian had no effect on the central nervous system, in small doses. The analgesic effect of the morphine and its duration was greater with the association of the Irradian. In small doses Irradian had a positive inotropic activity, the coronary irrigation was higher, and the coronary resistance was smaller and increased the oxygen in the cardiac apparatus. (auth) (TSS)

2881 STUDY OF THE OPHTHALMOLOGIC STATUS IN CHILDREN EXPOSED TO ATOMIC BOMB IN-UTERO IN NAGASAKI. Kawamoto, Sadahisa; Fujino, Tadashi; Fujisawa, Hideo (Atomic Bomb Casualty Commission, Nagasaki). Contract AT(49-1)-Gen-72. Nippon Shonika Gakkai Zasshi, 60(June 1968). (TID-24157).

An ophthalmologic study was conducted from August 1963 to March 1964 on 266 children who were in-utero at the time of the atomic bombing of Nagasaki. These children were divided into three comparison groups, including those whose mothers were within 2,000 m. from the hypocenter, whose mothers were between 3,000 and 4,999 m. from the hypocenter, and whose mothers were not in the city at the time of the explosion. Results showed that visual disability was more frequently noted in the children whose mothers were not-in-city, and no difference was noted by sex or by distance for those within the city. Lenticular opacities, including small vacuoles, were more frequently found in the group whose mothers were within the city, but no statistically significant difference was observed. (auth) (TSS)

2882 PLACENTAL LOCALIZATION USING ^{51}Cr-LABELED ERYTHROCYTES. Crossley, John (Southmead Hospital, Bristol, Eng.); Elder, M. G.; Muir, K. M. J. Obstet. Gynaecol. Brit. Commonwealth, 75: 474-6(Apr. 1968).

The use of ^{51}Cr-labeled red cells for placental localization with only 30 μCi of ^{51}Cr was described for 51 patients with antepartum hemorrhage. The area of the abdomen to be scanned was charted in a 4 × 4 grid. A count was taken over the precordium 10 min after intravenous injection, and then each square was counted at right angles to the skin surface. The count rate over each square was expressed as a percentage of the precordial count. The mean figure over the abdomen was calculated, and all areas 10% greater than the mean were shaded in on the chart reproducing the grid. Placental localization was found to be 94.1% correct. The use of ^{51}Cr-labeled red cells produced results comparable with the best obtained by any other method. The advantage of this technique was its ease of execution and accuracy, even at periods of gestation of less than 34 weeks, when soft tissue placentography tended to be inaccurate. The mother received about 12 mrad and the fetus about 2 mrad of γ irradiation from 20 μCi of ^{51}Cr. This method was preferable to using ^{131}I-serum albumin, for although the radiation was comparable, ^{131}I was detrimental to the maternal and fetal thyroids, unless blocked by Lugol's iodine solution. Serum albumin labeled with ^{132}I gave a lower radiation dose but had a short half-life. (BBB)

2883 PLACENTAL LOCALIZATION USING ^{99m}Tc-LABELED SERUM ALBUMIN. Beazley, J. M. (Univ., Sheffield, Eng.); Matthews, Jennifer C.; Leaver, E. Pauline; Smith, G. M. J. Obstet. Gynaecol. Brit. Commonwealth, 75: 470-3(Apr. 1968).

Methods for preparation of ^{99m}Tc-labeled serum albumin (^{99m}Tc-HSA), radiation dosage, results of placental scanning, and advantages of ^{99m}Tc-HSA are reported. Usually, one to two hr before intravenous injection of 100 mCi of ^{99m}Tc-HSA, 200 mg of $KClO_4$ was administered orally to the patient as a precaution against any uptake of unbound ^{99m}Tc by the maternal or fetal thyroid. Scanning was started two or three min after the intravenous injection. The main radiation hazard from ^{99m}Tc-HSA was to blood. The total absorbed dose from 100 mCi was ~4.7 mrad to maternal blood, and 1.4 mrad to fetal blood. When prepared for administration, 98% of ^{99m}Tc was bound to serum albumin. However, some ^{99m}Tc was released following intravenous injection. Only 70% of the ^{99m}Tc remained protein-bound after two hr, and 46% of the administered ^{99m}Tc was excreted in the urine during 24 hr. The presence of ^{99m}Tc in the bladder did not interfere with placental localization, since the scan was usually completed within 10 min of the intravenous injection. The placental site could be determined before amniocentesis, after antepartum hemorrhage, or when the fetal lie remained persistently unstable. The advantages of ^{99m}Tc included the absence of any primary β emission, a short half life (six hr), a low energy γ emission (140 KeV), and chemical properties that permitted easy labeling of serum albumin. All radioisotopic methods of placental localization shared the disadvantage that they provided no fetal picture, but they could detect the placental site at a much earlier stage in pregnancy than was possible radiographically, and with less radiation hazard to the mother and fetus. With a collimated scintillation counter and 100 mCi of ^{99m}Tc-HSA, the placenta could be located from the 28th week onwards in a high % of the patients. (BBB)

2884 PLACENTAL LOCALIZATION BY SCINTILLATION SCANNING USING ^{99m}Tc-LABELED HUMAN SERUM ALBUMIN. Walker, R. H. Secker; Kohorn, E. I. (Univ., London). J. Obstet. Gynaecol. Brit. Commonwealth, 75: 464-9(Apr. 1968).

The preparation of ^{99m}Tc-labeled human serum albumin (^{99m}Tc-HSA), its use in placental scanning, transfer from blood to placenta, and excretion are described and discussed. In 50 patients who had placental scans the indications for scanning were antepartum hemorrhage, unstable lie, and as a preliminary to amniocentesis. Each patient was given 200 mg of $KClO_4$ two hr before the scan and again six hr later in order to reduce the uptake of free $^{99m}TcO_4$ by both the maternal and fetal thyroid glands. Scanning was started five min after the intravenous injection of ^{99m}Tc-HSA, 4 μCi/Kg body wt (200 to 350 μCi). The procedure took 30 to 40 min to complete. In addition to the placental blood pool an outline of the uterine wall was visible for a large part of its course in most of the scans. There were no untoward reactions following the injection of ^{99m}Tc-HSA. Whole-body counts carried out on three babies within eight to 36 hr of delivery indicated that the babies contained 0.4 to 0.5% of the dose given. The excretion of ^{99m}Tc after intravenous injection of ^{99m}Tc-HSA was about 4% in the first hr, 14% in three hr, and 24% in 22 hr. The results with 250 μCi ^{99m}Tc-HSA compared favorably with other methods. Only ^{132}I-HSA gave less irradiation to the fetus, but more to the fetal thyroid, but its high energy γ rays made it unsuitable for use with a focusing collimator, while its short half-life meant that high speed was necessary. When ^{132}I was eluted from a ^{132}Te column, it contained 1 to 2% ^{131}I and this limited the amount of ^{132}I that could be given without increasing fetal thyroid irradiation. The radiation received by both mother and fetus was equivalent to two weeks' natural irradiation at sea level. When ^{99m}Tc-HSA was used for placental localization by the established method of surface counting over the

abdomen with as little as 20 μCi, the irradiation received by both mother and fetus was then less than 0.4 mrad. (BBB) (TSS)

2885 EPITHELIAL RADIOLESIONS: THEIR PROPHYLAXIS AND TREATMENT BY TOPICAL APPLICATION OF PANTOTHENIC ACID. Casanueva, Carlos Lueje. Radiologia (Panama), 18: 27-32(Dec. 1967). (In Spanish).

The occurrence, prevention, and treatment of injury to the epithelium in irradiated patients was reviewed, and the prevention and treatment of such injuries with pantothenic acid was recounted. The relatively high radiosensitivity of epithelial surfaces, including the skin, resulted in lesions, that healed only with difficulty, with all techniques of radiotherapy and radiation sources. The pathogenesis of cutaneous radioinduced erythema, dermatitis, and necrosis was discussed, as were various local and systemic treatments that were used for these lesions. Pantothenol, the alcohol form of pantothenic acid, used with and without cortisone given orally or topically, appeared to aid in the repair of radioinjured epithelium. It was postulated to have a dual action in this regard: it could stimulate mitotic activity as well as function as a vitamin to stimulate enzyme activity that might be impaired as a result of irradiation. It could be absorbed directly from the skin and was demonstrated to promote local re-epitheliazation and granulation tissue formation. An example was described and illustrations presented of the total restoration of epithelium without local depigmentation in a patient with a facial spinocellular epithelioma and keratinizing ulcer treated with 10,000 R of soft x irradiation and daily applications of pantothenol for 25 days. (BBB)

2886 SEVERE INTESTINAL COMPLICATIONS OF IRRADIATION OF VESICAL CANCER: APROPOS OF TWO CASES. Xerri, A. J. Urol. Nephrol., 72: Suppl, 379-84(Dec. 1966). (In French).

Two cases were studied in which irradiation of urinary bladder cancer produced serious complications. The first case was that of a 64-yr-old man who was irradiated three years before with a 6000-R dose of telecobalt γ rays over eight weeks for papillary epithelioma. A barium gastrointestinal x-ray study showed sigmoid occlusion. The second case was that of a 58-yr-old man who was irradiated for paramalphigian anaplasic carcinoma spreading to the muscle tissue. He had received 4500 R in 31 days from a betatron. Fifteen months later he showed digestive disorders, acute intestinal obstruction, and, on operation, severe sclerosis of the cecum. Methods of avoiding such radioinduced lesions were discussed. It was concluded that such serious complications as in these two cases were rare and that they did not detract from the overall benefits of radiation treatment. (BBB)

2887 EFFECT OF TETRACYCLINE AND CORTISONE ACETATE ON RADIORESISTANCE OF ADRENALECTOMIZED ANIMALS. Dumova, A. M.; Loginov, A. V. (Pharmacological Lab., Leningrad). Probl. Endokrinol. Gormonoter., 11: 62-7 (Mar.-Apr. 1965). (In Russian).

Three series of experiments were carried out on rats. The first series included 157 rats (wt 100 to 130 g) in three groups, all receiving orally a 100- to 150-mg/Kg dose of tetracycline hydrochloride twice a day. A single dose of 750 R of whole-body x irradiation (the LD_{100} for control rats) was given in all experiments. Group 1 was bilaterally adrenalectomized on the third day after discontinuation of tetracycline treatment, group 2 received the antibiotic orally immediately after adrenalectomy, and group 3 the same treatment five to seven days after adrenalectomy. The resultant irradiation effects in group 1 were reflected by less severe symptoms and later death of the animals, while groups 2 and 3 showed no increased resistance to irradiation. The second series included 142 nonadrenalectomized rats (wt 150 g), in four subgroups, one of which included rats receiving solely tetracycline treatment for 14 days prior to irradiation; subgroup 2 received for the same period tetracycline and cortisone acetate treatment, subgroup 3 only cortisone acetate, while subgroup 4 was the control. The tetracycline treatment was discontinued three days prior to irradiation and that of cortisone acetate (doses 1 and 5 mg/150 g wt) 20 hr before irradiation. Collectively, 34% of rats survived, but all rats of subgroup 3 died. The third series included 143 adrenalectomized rats used in subgroups and procedures similar to those of series 2. The postirradiation results revealed that 75% of rats that received the 1 mg dose of cortisone acetate in combination with tetracycline pretreatment survived. This suggested that the thalamo-hypophyseal-adrenal system participated in the protective action of tetracycline against the effects of x rays, and that pretreatment stimulated the adaptive action of hormones toward the stress. (BBB)

2888 RADIOPROTECTIVE EFFECT OF SALTS OF S-ALKYLSUBSTITUTED DERIVATIVES OF ISOTHIOUREA IN THE CASE OF SEPARATE AND COMBINED ADMINISTRATION. Zherebchenko, P. G.; Zil'ber, Yu. D.; Pospekhova, G. P.; Rachinskii, F. Yu.; Slavachevskaya, N. M.; Tank, L. I. (Military Medical Academy, Leningrad). Radiobiologiya, 8: 582-7(1968). (In Russian).

The radioprotective effect of salts of S-ethylisothiourea (ethyron) and other S-alkyl derivatives of isothiourea, as well as combinations of ethyron and other protectors, was studied. The investigation was conducted on white mice, x-irradiated at absolutely lethal (700 R) and supralethal (850 R) doses. It was found that the chemical structure of the anion does not influence the radioprotective activity of ethyron, that is manifested within a broad range of doses (12.5-150 mg/kg). In the case of simultaneous parenteral administration, ethyron increases the radioprotective action of the monosodium salt of β-aminoethylthiophosphoric acid (cystaphos) and does not influence the effect of 5-methoxytryptamine. The data obtained are evidence that ethyron differs from the aminothiols in the mechanism of its action and is similar to indolylalkylamines. (JPRS)

2889 ^{137}Cs THERAPY OF TUMORS OF THE CENTRAL NERVOUS SYSTEM, ACCESSORIES FOR SHAPING THE BEAM. Vaghi, M. A.; Pesce, S.; Ciancia, C. (Istituto Neurologico, Milan). Radiobiol. Radioter. Fis. Med., 23: 27-42(Jan.-Feb. 1968). (In Italian).

Cesium-137 γ teletherapy satisfies the fundamental requirements for therapy of neoplasms of the central nervous system, especially if administered with some accessories for varying the shape of the irradiating beam. These accessories, that are used in roentgentherapy and ^{60}Co γ teletherapy, have been used very rarely in ^{137}Cs teletherapy. They include beam flattening filters, wedge filters, eye protectors, and limiting cones. (auth)

2890 FACTORS INFLUENCING RADIOSENSITIVITY OF ANIMAL TUMOURS. Inch, W. R.; McCredie, J. A. (Victoria Hospital, London, Ont.). Can. Med. Ass. J., 99: 337-42(Aug. 24 and 31, 1968).

The cellular component of a tumor can be quantitated using the statistical method developed by Chalkley for examining histologica. sections. This is a convenient technique for studying vascular and morphologic changes during growth. Using this technique, the results that were obtained for the spontaneous C3 : tumor, isoimplants of this tumor and isotransplants of the C3HBA tumor correlated well with the deviation of the tumor growth curve from an exponential relation. The C3H isoimplant differed markedly in cellular composition and vascularity from the spontaneous C3H tumor. Vasodilator drugs such as chlorpromazine, isoproterenol, amyl nitrite, and adrenaline decreased tumor oxygen diffusion current measured in anoxic regions and were probably not a useful adjunct in radiotherapy. On the other hand, felypressin, a synthetic polypeptide related to vasopressin, increased the oxygen diffusion current and improved the rate of cure of tumors when given before radiation. Inhalation of a mixture of 5% CO_2 and 95% O_2 also increased the oxygen diffusion current in anoxic regions in a tumor and when given shortly before and during radiotherapy improved the rate of cure of poorly vascularized tumors. Inhalation of 5% CO_2 and 95% O_2 at one atmosphere pressure during radiotherapy may, therefore, be of clinical value. (auth) (Canada)

2891 EFFECT OF ERYTHROPOIETIN AND SALMONELLA TYPHI ENDOTOXIN ON SURVIVAL OF IRRADIATED MICE. Toth, Laszlo; Feher, Imre (Staatliche Forschungsinstitut fuer Strahlenbiologie und Strahlenhygiene, Budapest). Strahlentherapie, 136: 360-4(Sept. 1968). (In German).

Mice given endotoxin after x irradiation at 800 R, while having their tails shielded, were subjected to a continuous erythropoietin treatment immediately after irradiation. In spite of the rise of cell count in the bone marrow this exerted an unfavorable effect on their survival ratio. On the other hand, erythropoietin treatment beginning at the start of regeneration had no effect on survival any more. As a result of erythropoietin treatment, a higher number of intestinal deaths occurred. On the other hand, the number of intestinal deaths decreased when erythropoiesis was suppressed by hypertransfusion. (auth)

2892 MILD GASTRIC FUNDAL IRRADIATION IN THE TREATMENT OF PEPTIC ESOPHAGITIS. Cooper, James N.; Gelzayd, Eugene A.; Kirsner, Joseph B. (Univ. of Chicago). Gastrointest. Endoscopy, 14: 222-4(May 1968).

The effect of irradiation of the stomach on gastric acid secretion was studied in 20 patients irradiated for intractable peptic esophagitis. Two portals (anterior and posterior) over the area of the gastric fundus were treated with 160 rad per session for a 10-day period, for a total tissue dose of 1600 rad. As complications of therapy, two patients experienced transient increase in dysphagia during the period of irradiation. However, this difficulty subsided immediately upon completion of therapy. One patient

experienced intense nausea, and another developed left upper lobe pneumonitis associated with herpes zoster dermatitis. Most patients experienced an excellent or good short- and long-term response to therapy. However, four patients reported an increase in symptoms after one yr. Nine patients had no evidence of bleeding after gastric irradiation for as long as 10 yr. Recurrent bleeding was observed in five patients, three of whom had associated peptic ulcer disease. Of 12 patients who had follow-up gastric analyses, five with basal achlorhydria or more than a 50% reduction in stimulated acid output had an excellent or good symptomatic response. However, a direct correlation between smaller changes in gastric acid output and the symptomatic response was not observed. (BBB)

2893 PROTHESES FOR PROTECTION DURING INTERSTITIAL RADIUM THERAPY IN STOMATOLOGY. Lecacheux, B. (Centre Anticancereux Regional, Caen, France); Grellet, J. Entretiens Bichat, Stomatol., 5: 15(1966). (In French).

Radium-bearing prostheses were abandoned in treatment of mouth cancer, primarily because of the nonhomogeneous quality of irradiation produced, and interstitial curietherapy was used instead. Protection, however, was difficult with this method, especially when a protective shield was used. Different types of protheses for separating the radiation source from the patient were discussed and illustrated. Efficiency of protection obtained was considered. Doses received by the mandible both with and without prosthesis were calculated. Dosimetry was conducted with spacial reconstruction and direct readings with ionization chambers. The dose received averaged 50% less with the protective apparatus described than without. Heavy isodoses levels were prevented by the prothesis, and point doses were very small at the alveolar crests and along the gum line were radionecrosis commonly starts. Independently of protection, the intercalary apparatus eliminated radioepithelitis of the tongue and lip. The use of ^{192}Ir and its advantages over Ra in protection and practicability were discussed. (BBB)

2894 DIAGNOSTIC USE OF RADIOISOTOPES IN INTERNAL MEDICINE. Larizza, P. (Univ., Perugia, Italy). Minerva Med. Sicil., 13: 1-10(Jan.-Mar. 1968). (In Italian).

The diagnostic use of radioisotopes in internal medicine is illustrated by a review of the experience obtained in the Medical Clinic of Perugia. The scintigraphy of the thyroid, lungs, liver, pancreas, spleen, kidneys, lymph glands, and the head is reported and illustrated by typical scintigrams obtained for each. (J.S.R.)

2895 SEVERE URINARY COMPLICATION OCCURRING DURING TREATMENT OF EPITHELIOMA OF THE CERVIX UTERI. Chevillotte, R. Bull. Soc. Chir. Paris, 56: 244-9 (Oct. 7, 1966). (In French).

A 36-yr-old woman received ^{60}Co irradiation in 1960 for epithelioma of the cervix. Telecobalt therapy was used in four fixed fields and a total dose of about 3500 R was received of which only 20% (700 R) was to the bladder. Hysterectomy followed after apparent healing of the irradiated area. Epidermoid carcinoma resulted from radiotherapy and urinary complications followed, including a vesicovaginal fistula, as a result of tissue radionecrosis. It was not until 1963, after a series of surgical operations and further severe complications, that the patient was finally cured and now leads a normal life. Grave complications in cases of cervical cancer can occur when preoperative cobalt therapy and radical pelvic surgery are used together. (BBB)

2896 ELECTROENCEPHALOGRAPHIC EFFECTS INDUCED BY ENDOCAROTID ADMINISTRATION OF ^{131}I-MAA. Laura, A.; Mastroeni, G. (Univ., Messina, Italy). Minerva Med. Sicil., 13: 90-6(Jan.-Mar. 1968). (In Italian).

A study was made to determine if the inoculation of ^{131}I-MAA, introduced by endocarotid administration, in the scintigraphic diagnosis of the cerebral hemispheres, can show modifications of the cerebral bioelectrical activity. In 16 patients exposed to EEG examination, there were 11 cases of an increase of the electric activity; in four cases there was a decrease; in one case there was no modification. Considering that in the four patients in which there was a decrease, the ^{131}I-MAA was injected immediately after carotid angiography with suitable contrast material. The results showed that ^{131}I-MAA does not cause damage of the encephalon that can be detected by electroencephalography. (tr-auth)

2897 SCINTIGRAPHY OF LYMPH NODES. Gasso, G. (Centro Catanese di Oncologia, Catania, Italy). Minerva Med. Sicil., 13: 97-102(Jan.-Mar. 1968). (In Italian).

Results obtained from the scintigraphy of lymph nodes using ^{198}Au in colloidal suspension were illustrated. These results showed that scintigraphy of the lymph nodes can give anatomic, functional, and morphological data easily and with few side effects. (J.S.R.)

2898 USE OF ARTIFICIAL RADIOISOTOPES FOR TOPOGRAPHIC LOCALIZATION OF PELVIC LYMPH NODES. Maneschi, M.; Ragonese, P.; Scio, A. (Univ., Palermo, Italy). Minerva Med. Sicil., 13: 103-7(Jan.-Mar. 1968). (In Italian).

The use of colloidal ^{198}Au alone or of ^{131}I-labeled lipiodol in conjunction with colloidal ^{198}Au for the topographic localization of pelvic lymph nodes was investigated. Best results were obtained with the mixture of the two isotopes. Typical examples are shown of the lymphographs obtained. (J.S.R.)

2899 ISOTOPE NEPHROGRAM AFTER ADMINISTRATION OF DESTRANO OF LOW MOLECULAR WEIGHT AND OF MANNITOLO FOR EVALUATION OF RENAL DAMAGE IN OBSTRUCTIVE UROPATHY. Russo, A.; Di Benedetto, A.; Magnana, L.; Rizza, G. (Univ., Catania, Italy). Minerva Med. Sicil., 13: 115-22(Jan.-Mar. 1968). (In Italian).

The effects of low-molecular weight dextran and of mannitol on the isotopic nephrogram for the evaluation of renal damage in obstructive uropathy were studied. The results showed that both substances affected the radionephrographic curves, but only the dextran permitted an evaluation of the effective functional condition of the kidney. (tr-auth)

2900 ROENTGEN STAND FOR FIELD POSITIONING IN HIGH ENERGY RADIOTHERAPY. Jung, B.; Larsson, B.; Rosengren, B.; Staal, K.; Wretlind, W. Acta Radiol., Ther., Phys., Biol., 7: 282-8(Aug. 1968).

A unit for use in dose planning and field localization with a roentgen source and an image amplifier, mechanically coupled together by an arc, is described. The arc can be rotated isocentrically around two perpendicular axes. The focus-isocentrum and image planeisocentrum distances are both variable. (auth) (Swed)

2901 EFFECTS OF RADIATION ON THE SURVIVAL AND ELASTOVISCOUS PROPERTIES OF DNA ISOLATED FROM BACTERIA IRRADIATED UNDER DEEP COOLING AND WITH PROTECTION BY THIOUREA. Shekhtman, Ya. L.; Moiseenko, E. V.; Breiksh, I. V.; Borisova, M. P. (Inst. of Biological Physics, Pushchino, USSR). Radiobiologiya, 8: 483-8(1968). (In Russian).

A comparative study was made of the effects of radiation on the elastoviscous properties of the supermolecular structures of DNA and damage to E. coli cells. The correlation between survival rate and the change in the elastoviscous properties of DNA was demonstrated within the dose range of 2 to 8 kR, as well as in the case of irradiation of bacteria under conditions of deep cooling and in the presence of thiourea. (JPRS)

2902 RADIOISOTOPE BRAIN SCANNING IN OTOLOGICAL PRACTICE. Valergakis, Frederick E. G. Laryngoscope, 77: 2178-88(Dec. 1967).

Three diagnostically difficult cases involving the mastoid area and auditory systems were presented, where the radioisotope study disclosed the presence of the lesion, its location, and size. The greatest danger was irradiation of the kidneys. It was estimated that the radiation dose to the kidneys was 35 to 40 R from a brain scanning dose of 10 μC/kg of ^{203}Hg. By substituting ^{197}Hg, that delivered a radiation dose to the kidneys of about $\frac{1}{8}$ that of the long-lived ^{203}Hg, the danger of renal damage was largely eliminated. The whole-body irradiation from a radioactive Hg study was estimated to be 290 R, which was about the skin dose a patient receives in the routine x ray of the chest. The radioisotope brain scan was a rapid screening technique, more accurate in detecting intracranial masses than the routine skull x-ray studies and the electroencephalogram, but not so accurate as the pneumoencephalogram or arteriogram. Small tumors and midline tumors escaped detection and required contrast studies for detection. (BBB)

Radiation Effects on Animals

Refer also to abstracts 2740 and 2857.

2903 (AEC-tr-6774) RADIOBIOLOGY. Translation of Radiobiologiya, 6: No. 5, 641-776(1966). 207p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2904 (AEC-tr-6775) RADIOBIOLOGY. Translation of Radiobiologiya, 6: No. 6, 777-936(1966). 272p. Dep. CFSTI. JCL $17.50 fs, $8.39 mf.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2905 (AEC-tr-6887) RADIOBIOLOGY. Translation of Radiobiologiya, 7: No. 2, 163-312(1967). 263p. Dep. CFSTI. JCL $17.00 fs, $8.09 mf.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2906 (AEC-tr-6888) RADIOBIOLOGY. Translation of Radiobiologiya, 7: No. 3, 315-488(1967). 298p. Dep. CFSTI. JCL $18.50 fs, $9.17 mf.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2907 (AEC-tr-6889) RADIOBIOLOGY. Translation of Radiobiologiya, 7: No. 4, 491-640(1967). 253p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2908 (AEC-tr-6891) RADIOBIOLOGY. Translation of Radiobiologiya, 7: No. 6, 1-271(1967). 275p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2909 (AEC-tr-6950) RADIOBIOLOGY. Translation of Radiobiologiya, 8: No. 1, 1-306(1968). 311p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2910 (AEC-tr-6954) RADIOBIOLOGY. Translation of Radiobiologiya, 7: No. 5, 643-816(1967). 287p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

Invertebrates

Refer also to abstracts 2793, 2795, 2805, and 2813.

2911 (UCRL-Trans-10280) SENSITIVITY OF SPERM TO X-RAYS STUDIED IN THE FACULTATIVELY PARTHENOGENETIC PHASMIDIAN BACILLUS ROSSIUS. Benazzi, M.; Scali, V. Translated by B. J. Hazzard for Univ. of California Lawrence Radistion Lab., Livermore, from Atti Accad. Naz. Lincei, Rend., Cl. Sci., Fis., Mat. Natur., 36: 794-7(1964). 8p. Dep. CFSTI.

Nematode worms of the order Phasmidia were collected from the area of Pisa. Reproduction in this group occurs by normal fertilization or by parthenogenesis; the offspring resulting from the latter method are females only. Male worms were x-irradiated with doses of 500 to 20,000 R. With doses up to 5000 R the offspring were of both sexes; however, the number of offspring decreased with increasing doses owing to embryonic mortality. Doses of 10,000 to 20,000 R resulted in female progeny only, indicating that all eggs developed parthenogenetically. Results are tabulated. (H.L.W.)

2912 EFFECT OF BLOOD-FEEDING ON THE LONGEVITY OF RADIATION-RESISTANT YELLOW-FEVER MOSQUITOES. Stahler, Nathan; Terzian, Levon A. (Naval Medical Research Inst., Bethesda, Md.). J. Econ. Entomol., 61: 1447(Oct. 15, 1968).

Experimental radioresistant mosquitoes (Aedes aegypti) and control parent mosquitoes were each divided into two groups: one group was fed on chicken blood; the other group was non-blood-fed. Oviposition occurred less frequently in the radioresistant strain than in the normal strain. The daily percent survival for the four groups is shown in the form of a graph. The results indicate that the radioresistant strain is shorter-lived than the normal strain and that blood feeding extends the life span of the resistant and normal strains. Blood-feeding did not prolong the life span of the radioresistant group to the extent that it equalled that of the normal nonblood-fed one. (H.L.W.)

2913 AN OUTLINE OF STUDIES ON THE CELLULAR BASIS OF PLANARIAN RADIATION LETHALITY. Lange, C. S. (Christie Hospital, Manchester, Eng.). J. Physiol. (London), 197: 54P-5P(July 1968).

The effect of radiation on planarians, consisting of triclad platyhelminths known for their extensive powers of regeneration, was studied with particular reference to the cellular basis of animal mortality probability. Postirradiation survival of this organism was explained in terms of the rate of decay of function of the differentiated tissues and the reproductive integrity of the stem-cell population. The survival of neoblast (stem cell) reproductive integrity for Dugesia lugubris was determined assuming a simple relation between stem-cell reproductive integrity and animal mortality probability, which necessitated the measurement of stem-cell population size and repopulation probability. This model represented mortality probability in terms of cellular reproductive integrity, that was further validated by the experimental confirmation of a prediction of the model. The variables considered permitted the survival of the organism to be defined in terms of the reproductive integrity of its stem cells. Under other conditions the rate of decay of function of the differentiated tissues would also have to be taken into account. Growth of spontaneous tumors was due to faulty differentiation control rather than neoplasia. Histological studies were made to determine the number and distribution of neoblasts per animal in diploid, triploid, and tetraploid D. lugubris. The number of neoblasts per animal (N_0) was found to be independent of ploidy. A highly significant correlation was found between log N and the log of the animal length or volume. Older animals had more neoblasts, but their density was lower. The patterns of change in neoblast distribution with age suggested different modes of growth in the diploid and polyploid cells. The dose-response curve of animal cells under conditions of normal growth regulation in an organized tissue in vivo was determined. The use of the multitarget type survival curve gave meaningful results for cells under normal in vivo conditions, where cells were not in a state of continuous turnover. No protective effect of polyploidy against radiation was found. (BBB)

2914 CONTROLLING THE COCKCHAFER(MELOLONTHA MELOLONTHA) BY THE STERILE MALE TECHNIQUE. Jermy, T.; Nagy, B. (Research Inst. for Plant Protection, Budapest). Acta Phytopathol., 2: 211-17(1967).

Irradiation of cockchafer (Melolontha melolontha) males dug out of soil before emergence with 3 kr of x rays or γ rays sterilized 98% to 100% of the beetles. X-rays and γ rays had the same sterilizing effect at the dose rates used in these tests (8.5 kr/min for x rays and 2.82-3kr/hr for gamma-rays). Feeding before irradiation (oak and cherry leaves) did not seem to affect sterilization. Male cockchafers irradiated with 3kr of x rays or γ rays mated as frequently as normal males under laboratory conditions. Irradiation also caused increased locomotion of male beetles, even during irradiation at 12°C. No differences in longevity of irradiated and nonirradiated male beetles were observed. The competitiveness of irradiated males under natural conditions, and thus the usefulness of the sterile male technique in controlling this insect pest, was not demonstrated. (JPRS)

2915 EFFECTS OF X RAYS ON OOGENESIS AND RHYTHM OF MOLTING IN ARTEMIA SALINA LEACH. Ballardin, E.; Metalli, P. (CNEN, Rome). Boll. Zool., 33: 195-6(1966). (In Italian). (RT/BIO-(67)26).

Diploid and tetraploid strains of Artemia salina were exposed to single x-ray doses up to 100 krad. The effects on the oogenesis and the molting rhythm were determined. The results showed that in virgin females radiation doses up to 60 krad inhibited the first egg laying. These doses do not affect the molting rhythm. At doses between 80 and 100 krad a first post-irradiation molting was observed in almost all the animals. It is concluded that Artemia salina exhibits two types of death after irradiation. For doses up to 60 Krad death is not preceded by any alterations in the molting rhythm. For higher doses death is associated with the blocking of the molting rhythm and with the characteristics of an acute syndrome accompanying clear modifications of other physiological functions. (J.S.R.)

Vertebrates

Refer also to abstracts 2741, 2745, 2746, 2750, 2761, 2762, 2764, 2771–2773, 2776, 2780, 2781, 2785, 2787, 2797, 2802, 2812, 2818, 2858, 2859, 2865, 2873, 2878, 2880, 2887, 2888, and 2891.

2916 (AD-661094) LASER RADIATION EFFECTS ON THE MORPHOLOGY AND FUNCTION OF OCULAR TISSUE. Annual Report No. 1. Jones, Arthur E.; Fairchild, David D. (Honeywell, Inc., St. Paul, Minn. Research Dept.). Aug. 1967. Contract DADA17-67-C-0019. 52p. (12047-TDR-1). CFSTI.

A study was made of the effects of laser radiation on the structure and function of the primate retina. The program encompasses the ocular effects of pulsed and CW laser radiation through anatomical studies of laser-exposed and non-exposed tissue at the resolution of both light and electron optics. These are directed toward studies of the chemical morphology of retinal structures through enzyme and other staining techniques. Analysis of bioelectric potentials in the visual system is studied. The electroretinogram recorded from the intact eye is used to follow long-term effects of laser radiation. The LERG (localized electroretinogram) will be used to study localized effects of laser radiation. Single unit recording from the fourth-order neurons (LGN) of the visual system will be used to study photochemical effects of laser radiation. Laser-induced changes in retinal metabolism are being investigated through autoradiographic studies of ^{14}C labeled vitamin A. Laser

exposures of the macula of rhesus and mangabey monkeys are made in conjunction with ERG studies. These animals are trained to perform in testing apparatus and are tested for visual defects. (TAB)

2917 (AFRRI-SR-68-10) EFFECTIVENESS OF DRUGS IN ANIMALS EXPOSED TO MIXED GAMMA-NEUTRON RADIATIONS. II. ANTICONVULSANTS. Davis, L. W.; Strike, T. A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). May 1968. 13p.

The effectiveness of four anticonvulsants was tested in male CF_1 mice exposed to 500-, 1000-, and 10,000-rad doses of mixed γ-neutron radiations. Prevention of the hind leg extensor component of a maximal convulsion induced by electroshock was selected as the end point for effective anticonvulsant activity of diphenylhydantoin, phenobarbital, and mephenytoin. Prevention of convulsions induced by pentylenetetrazol was the end point of effective anticonvulsant activity of trimethadione. The effectiveness of the drugs was evaluated by comparing the ED_{50}'s to the ED_{50} value of unirradiated controls. The anticonvulsants tested by electroshock showed a tendency toward increasing effectiveness after 500- and 1000-rad doses of radiation and a significantly increased effectiveness following 10,000 rads. Trimethadione effectiveness in irradiated mice was similar to that in unirradiated controls at all doses and times tested. (auth)

2918 (AFRRI-SR-68-12) EFFECTIVENESS OF DRUGS IN ANIMALS EXPOSED TO MIXED GAMMA-NEUTRON RADIATIONS. IV. DRUG TOXICITY. Davis, L. W.; Strike, T. A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). May 1968. 13p.

The acute toxicity (death within 24 hours) of 10 drugs representing four drug classes (anticonvulsants, hypnotics, hypoglycemics, and psychopharmacologics) was studied in irradiated male CF_1 mice two hr, one day, or six days after 500-, 1000-, and 10,000-rad whole body doses of mixed γ-neutron radiations. The LD_{50} value for each drug in irradiated mice was calculated and compared to the LD_{50} value obtained in unirradiated controls. Although the LD_{50} values for most drugs studied were altered significantly in some of the dose groups of irradiated mice, no definite pattern of change of drug toxicity with respect to either radiation dose or postirradiation time was identified. (auth)

2919 (ANL-7409) BIOLOGICAL AND MEDICAL RESEARCH DIVISION ANNUAL REPORT, 1967. (Argonne National Lab., Ill.). Dec. 1967. Contract W-31-109-Eng-38. 300p. Dep. CFSTI.

Research activities are reported in the following areas of investigation: biophysical studies of molecular interactions, radiation effects on cultured cells, and factors affecting radiosensitivity; analysis of radiation effects on cells at the biochemical level, and the biosynthesis of macromolecules; biosynthesis and activity of enzymes in various pathways and the effects of ionizing radiation on these phenomena; preparation, detection, analysis, and effects of radioisotopes in tracer studies; investigations of biochemical activities at the ultrastructural level in cells; effects of hormones on phototropic mechanisms in plants; gravity compensation studies in irradiated and nonirradiated plants; studies in mammalian genetics and the effects of radiation on genetic patterns; microbial genetics and mutagenesis in microbial populations; radiobiological and biochemical studies of developmental phenomena among amphibia and insects; biochemical, biophysical, and radiobiological studies of the mechanisms of carcinogenesis in organisms; analysis of phenomena affording protection to tissues against radiation, including endogenous mechanisms; cellular and somatic effects of ionizing radiation on organisms, including factors affecting radiosensitivity and repair mechanisms; studies relating to the medical status of laboratory animals; theoretical studies in cellular and animal biology; radiation dosimetry studies; toxicity and metabolism of radioisotopes in beagle dogs; physiological and medical status of the beagle dog colony; and monitoring of radioisotope content of selected environments. A list of 116 publications is included as well as an author index to the research reports. (E.R.B.)

2920 (COO-1422-35) RADIATION EFFECTS ON BONE MINERAL CONTENT. Bartok, S. P.; Witt, R. M.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Radiology). July 22, 1968. Contract AT(11-1)-1422. 11p. Dep. CFSTI.

Results of a two week longitudinal study of ^{137}Cs γ radiation effects on mineral content of rabbit tibias appeared to be inconclusive. The mineral content of the tibias of both the irradiated and the control animals continually increased during the two week period. The total increase in mineral content for the controls ranged from 10% to 20%. The increases in the mineral content of both tibias for one group ranged from 10 to 35%; those for the other group ranged from 8 to 19%. The small aluminum bar that served as a phantom showed no change (<1%) during the two week period. Since the mineral content in both the control group and the experimental group increased by approximately the same amount and since the mineral content of the left tibias (control) and right tibias (irradiated) in the experimental group increased by approximately the same amount, the irradiation of the right tibias appeared to have had no effect on bone mineral during the two week study. What apparently was observed was a change in mineral content due to animal growth. Moreover, since no other measurements were made to monitor animal growth (e.g. daily weight), changes in bone mineral due to irradiation effects from those due to normal growth could not be separated. (B.S.L.)

2921 THE INFLUENCE OF PENICILLINS ON THE ACCUMULATING FUNCTION OF THE RETICULO-ENDOTHELIAL SYSTEM OF WHITE MICE DURING ACUTE RADIATION SICKNESS. Maleta, Yu. S. (All-Union Scientific Research Inst. of Antibiotics, Moscow). Radiobiologiya, 7: 876-80(1967). (In Russian).

Male white mice (400) weighing 18 to 20 g and females weighing 15 to 18 g were irradiated with x rays at a dose causing 90% mortality in 20 days. Treatment with penicillins began the day after irradiation. Benzylpenicillin, phenoxymethylpenicillin (10,000 units/kg), ampicillin, and oxacillin (25 mg/kg) were administered subcutaneously twice a day in isotonic NaCl solution, isotonic NaCl solution with 0.042% KCl, and 1.15% KCl solution. The penicillins were also administered perorally in 0.2 ml of isotonic NaCl solution and the solvents were administered to the control animals. When administered subcutaneously, ampicillin and phenoxymethylpenicillin stimulated the absorptive function of the reticuloendothelial system. Potassium ions intensified the positive action of the penicillins. Oxacillin applied subcutaneously did not produce stimulation. Phenoxymethylpenicillin administered perorally and oxacillin to a lesser degree accelerated the separation of India ink from the blood of irradiated mice and ampicillin retarded that process. (JPRS)

2922 THE EFFECTS OF MICRO-ORGANISMS ON RADIATION PATHOLOGY, AND BONE MARROW THERAPY IN WHOLE-BODY IRRADIATION. Wilson, Raphael (Univ. of Notre Dame, Ind.). J. Amer. Osteopath. Ass., 67: 653-62(Feb. 1968).

Radiation studies have utilized germfree animals to assess the effect of micro-organisms on the response of mammals to whole-body ionizing radiation, the recovery phenomena, bone marrow therapy, and the action of protective agents. This report reviews the results of radiation studies carried out with germfree mice, to determine the role of micro-organisms in survival time, hematologic changes, hypoferremia, intestinal effects, treatment with bone marrow, and survival in secondary disease. These studies indicate that bacteria and other agents contribute to the pathologic state by altering the normal anatomic and physiologic status of the host directly and through the pharmacologic action of products of microbial origin. (auth)

2923 RADIATION EFFECT ON THE BARRIER FUNCTION OF THE LYMPH NODE. AN EXPERIMENTAL STUDY. Herman, Peter G.; Benninghoff, David L.; Mellins, Harry Z. (State Univ. of New York, Brooklyn). Radiology, 91: 698-702(Oct. 1968).

The filtering efficiency of irradiated popliteal lymph nodes of the dog was investigated. The evaluation was based on microradiographs of midplane sections of the lymph node which, before removal had been challenged by subcutaneously administered thorium dioxide particles (Thorotrast). It was found that the quantity and distribution of thorium dioxide particles in the lymph node studied by microradiographic methods, is a useful semiquantitative index of the barrier function. Local x irradiation of 1,000 to 3,000 R in a single dose had no detectable effect on the filtering function of the popliteal lymph node of the dog. (auth)

2924 EXPERIMENTAL RADIATION-INDUCED HEART DISEASE IN RABBITS. Stewart, J. Robert; Fajardo, Luis F.; Cohn, Keith E.; Page, Vera (Stanford Univ., Palo Alto, Calif.). Radiology, 91: 814-17(Oct. 1968).

Forty-six rabbits were exposed to x radiation in doses from 1,570 to 8,200 rads to the heart region. The hearts of the animals were examined at various time intervals ranging from 33 to 91 days after irradiation for signs of radioinduced lesions. Three animals had necropsy evidence of heart failure after 6,050 to 8,250 rads, and eight showed slight to moderate pericardial fibrosis and moderate fibrosis of the epicardium was observed in eleven animals. Lesions of the myocardium were the most constant and severe changes observed. (C.H.)

2925 RESPONSE OF SAIMIRI SCIUREUS MONKEYS TO TOTAL BODY X-IRRADIATION: ELECTRON MICROSCOPIC CHANGES IN THE HEART. Allen, J. R.; Carstens, L. A. (Univ. of Wisconsin, Madison). Amer. J. Vet. Res., 29: 2189-2204(Nov. 1968).

Thirty-six Saimiri sciureus monkeys were given 800 R of total body x-irradiation. The mean survival time was 9.6 days. The myocardium of the monkeys was edematous and contained many hemorrhagic foci. Microscopically, bacterial foci were observed in a few smaller vessels and in intercellular spaces. The muscle cells were enlarged and widely separated. By electron microscopy, distinct morphologic changes were observed in the myocardium. There were dilatation of the intercellular spaces and dehiscence of many intercalated disks. There was loss of spatial relationship of the sarcoplasmic organelles. The myofibrils and filaments were separated, the sarcomeres were fragmented, and the sarcoplasmic matrix was increased. Some of the mitochondria were swollen, whereas others were shrunken and had distorted membranes. There were more lysosomes, sarcoplasmic vacuoles, and myelin figures. The capillary endothelial cells were shrunken and electron dense and had many vacuoles. There was also widening of the intercellular spaces. It was proposed that the changes in the hearts of the irradiated monkeys resulted from tissue hypoxia rather than from direct effect of irradiation on the myocardium. (auth)

2926 RESPONSE OF SAIMIRI SCIUREUS MONKEYS TO TOTAL BODY X-IRRADIATION: CLINICAL SIGNS AND PATHOLOGIC CHANGES. Allen, J. R.; Carstens, L. A. (Univ. of Wisconsin, Madison). Amer. J. Vet. Res., 29: 2179-88(Nov. 1968).

Thirty-six Saimiri sciureus monkeys were given 800 R of total body x-irradiation. Their mean survival time was 9.6 days. Diarrhea, vomiting, and conjunctivitis were observed during the initial 24 hours. Subsequently, the monkeys became anorectic and listless and developed petechiae over much of their external body surface. Anemia, leukopenia, and thrombocytopenia became more severe. Terminal bacteremia occurred in almost all of the irradiated monkeys just before they died. Gross and microscopic changes included extensive hemorrhage, edema, focal tissue necrosis, and many bacterial foci throughout the body. Hypocellular bone marrow, lymph nodes, and spleen were found in all irradiated monkeys. (auth)

2927 INFLUENCE OF ANESTHESIA ON RADIATION EFFECT. EXPERIMENTAL CATARACTS. Merriam, George R. Jr. (Columbia-Presbyterian Medical Center, New York); Focht, Elizabeth F.; Parsons, R. Wayne; Schwartz, Herman S. Radiology, 91: 694-7(Oct. 1968).

Rats anesthetized with sodium pentobarbital in three consecutive experiments were compared with unanesthetized animals in terms of the rapidity of development of cataracts after exposure of the eye to 1,000 to 1,500 rads of 200 kVp x rays in a single dose. One eye only of each animal was exposed, the fellow eye serving as a control. The animals were examined at regular intervals, and the cataracts graded 0, 1+, 2+, 3+, and 4+. The data were subjected to probit analysis, and a small but just statistically significant difference was found. The anesthetized rats showed, in general, a slight increase in the time of onset of a cataract. The final lens opacity induced was the same in all animals. The minimal difference found in these experiments indicates that no clinically significant difference would be expected in cataract onset for patients treated with or without such anesthetics. (auth)

2928 ACTION OF X-RADIATION OF THE SLEEP OF RATS. Riotte, Maurice; Chazot, Guy; Cier, Andre (Centre de Recherches du Service de Sante des Armees, Lyon. Laboratoire de Pharmacodynamie, Lyon). Compt. Rend., Ser. D, 267: 435-7(July 22, 1968). (In French).

Whole-body x-irradiation of rats with a lethal dose (800 R) caused a progressive decrease in the frequency of the rhomboencephalic phases of sleep, EEG recordings until their complete disappearance 24 hr before death. (tr-auth)

2929 RECEPTOR ORIGIN OF THE OLFACTORY BULB RESPONSE TO IONIZING RADIATION. Cooper, G. P. (Univ. of Cincinnati). Amer. J. Physiol., 215: 803-6(Oct. 1968).

Responses of olfactory bulb neutrons to 250-kVp x rays were examined in anesthetized rats in relation to the intensity and duration of irradiation. In anesthetized rabbits the olfactory epithelium was surgically exposed and the responses of olfactory bulb units to both 250-kVp x rays and β rays (strontium–yttrium) were studied. In rats it was found that the firing rate of an olfactory bulb unit is a linear function of the logarithm of the dose rate, for a threshold response the product of dose rate and exposure duration is a constant, for the most responsive units the threshold dose rate is 10 mR/sec and the threshold dose 5 mR, and the minimum response latency is approximately 125 msec. In rabbits, β irradiation produced responses of olfactory bulb neurons if, and only if, the beam was focused directly upon the olfactory epithelium. The population of units responsive to β irradiation was identical to that responsive to x irradiation. These data indicate that responses of the olfactory system to ionizing radiation are of receptor origin. (auth)

2930 ULTRAVIOLET LIGHT INDUCED CONNECTIVE TISSUE CHANGES IN RAT SKIN: A HISTOPATHOLOGIC AND HISTOCHEMICAL STUDY. Nakamura, Kinuyo; Johnson, Waine C. (Temple Univ. School of Medicine, Philadelphia. Skin and Cancer Hospital, Philadelphia). J. Invest. Dermatol., 51: 253-8(Oct. 1968).

The effect of uv radiation on connective tissue of rat skin was studied using histopathologic and histochemical methods. Thirty female albino rats were exposed to uv radiation three days a week for 27 weeks. Biopsies were taken from exposed and control animals every two weeks during a 46 week period. A prominent increase in acid mucosaccharide with histochemical properties of hyaluronic acid occurred in the superficial corium after three weeks of uv exposure and diminished when the uv was stopped. Alkaline phosphatase studies demonstrated significant vascular changes, reactive dermal fibrocytes, and focal diffuse alkaline phosphatase activity in the stroma of the papillary corium. As edema and cellular infiltration in the superficial corium increased, elastic fibers disappeared and remained virtually absent while exposure to light was continued. New elastic tissue fibers appeared in the superficial corium after uv was stopped and elastica gradually increased to abnormal quantities closely simulating solar elastosis of human skin. (auth)

2931 ULTRASTRUCTURAL STUDY OF THE HEMATOPOIETIC MARROW DURING THE COURSE OF REGENERATION AFTER IRRADIATION. Simar, L. J.; Haot, J.; Betz, E. H. (Univ., Liege). Eur. J. Cancer, 4: 529-35(Oct. 1968). (In French).

An ultrastructural study of the small lymphoid cells from bone marrow of x-irradiated mice was made. As compared with cells from bone marrow of control mice, the cells from irradiated mice were more heterogeneous, including lymphocytes, myeloid cells, erythrocytic cells, and others. A large number of cells of a special kind was noted; the nature and function of these cells are unknown. (H.L.W.)

2932 RELATIVE RADIATION SENSITIVITY OF CIRCULATING SMALL AND LARGE LYMPHOCYTES. Neff, R. D.; Cassen, B. (Univ. of California, Los Angeles). J. Nucl. Med., 9: 402-5 (July 1968).

Studies were made on the kinetics of the circulating lymphocyte response to radiation during the first 8 hr after irradiation and on the effect of radiation on the mitotic index of lymphocytes cultured in vitro. It was found that the rate of fall in peripheral lymphocyte count during the first 8 hr after 100 R and 200 R was independent of dose within that dose range and that there was no change in lymphocyte size distribution during this decrease in cell number. It was also observed that 1,000 R in vitro irradiation decreased the cell count at a much slower rate with still no change in size distribution. The mitotic index of lymphocytes from irradiated animals was found to be the same as that from normal animals when cultured for 3 days in the presence of Phytohemagglutinin M. The total number of cells surviving after 3 days was 20% less in the irradiated samples, but the fraction arrested in mitosis by colchicine was not significantly different from the controls. (auth)

2933 INCREASED GROWTH OF MYCOBACTERIUM LEPRAE IN THYMECTOMIZED-IRRADIATED MICE AFTER FOOD PAD INOCULATION. Shepard, Charles C. (Dept. of Health, Education, and Welfare, Atlanta); Congdon, Charles C. Int. J. Leprosy, 36: 224-7(1968).

It was confirmed that when thymectomized-irradiated mice were infected in the foot pads the local growth of M. leprae in the foot pads was distinctly increased over that seen in controls. In addition there was bacterial spread to the other feet, the ears, and nose in mice followed for long periods. The reason for reporting this confirmation is to emphasize that this technic, or other similar ones, appears to offer new approaches to the study of the immunology and pathogenesis of leprosy, and to provide a means for maintaining a laboratory supply of increased numbers of M. leprae in high viability. (auth)

2934 FURTHER STUDIES ON SERUM PROTEIN FORMATION BY CHIMERAS. I. EFFECT OF CYTOTOXIC AGENTS ON SERUM PROTEIN FORMATION. Phillips, Mildred E. (New York Univ., N. Y.). Proc. Soc. Exp. Biol. Med., 129: 78-83 (Oct. 1968).

Rat-into-mouse chimeras were produced by injection of rat bone marrow into irradiated or cyclophosphamide (CY) treated animals. Both groups of animals were given interval injections of CY during the first two weeks after the initial procedure. The degree of chimerism in the CY induced chimeras was limited

and confined only to hematopoietic tissues. Donor type serum proteins were never detected in cultures of spleens or peritoneal macrophages. In the x irradiated group, the only serum protein of donor origin produced by the chimeric tissues in vitro was transferrin, which correlated with its presence in the sera of these animals. (auth)

2935 EFFECTS OF FRACTIONATED RADIATION ON THE HEAD PHASE OF THE EMBRYONIC DEVELOPMENT OF THE MOUSE. Konermann, Gerhard (Univ., Freiburg i. B.). Strahlentherapie, 136: 336-48(Sept. 1968). (In German).

Embryos were x-irradiated with daily doses of 5 to 80 R at different periods of development of the head. The percent of normal, deformed, and dead fetuses resulting from this treatment is shown in the form of graphs. The 5 R dose had no effect on any of the developmental stages. A dose of 10 R reduced the percent of normal fetuses if the treatment extended beyond the fifth day of gestation. With increasing doses there was a corresponding decrease in the percent of normal fetuses. When a dose of 80 R per day was given during the period of organogenesis, only about 25% of the embryos were normal. Equal doses of radiation produced quite different results when administered during blastogenesis and during organogenesis. The most radiosensitive stage was found to be the pre-implantation embryo. It was found that a total dose given in small daily fractions over a longer period of time was less injurious than a corresponding total dose given at a higher daily rate over a shorter period of time. (H.L.W.)

2936 EXPERIMENTAL TUBERCULOSIS INFECTION IN THE IRRADIATED MOUSE. Ciocirlie, I.; Satmari, C.; Popescu, Tr. Rev. Sanit. Mil., 71: 53-64(Jan.-Feb. 1968). (In Rumanian).

Experiments were carried out on the reactions of mice (divided into groups of 50 animals each), infected with a concentrated suspension of Mycobacterium tuberculosis and exposed to different doses of x radiation. The results showed that irradiation of mice visibly influenced the evolution of tuberculosis, in relation to the irradiation dose. A small dose of x radiation (approximately 100 R) stimulated the resistance of the organism to infection, while a medium dose (approximately 250 R) lowered the defense potential of the organism, and the induced bacillary infection was more severe. A high dose (over 350 R) induced in mice acute forms of the disease, rapidly resulting in death of the animals. Other attempts at aggravating tuberculosis in mice (deficient diet and cortisone) did not give any results. (auth) (TSS)

2937 RENAL HOMOTRANSPLANTATION IN RATS: II. TOLERANT RECIPIENTS. Feldman, Joseph D.; Pick, Edgar; Lee, Sun; Silvers, Willys K.; Wilson, Darcy B. (Scripps Clinic and Research Foundation, La Jolla, Calif.). Amer. J. Pathol., 52: 687-700(Mar. 1968).

Lewis rats, tolerant of DA rat tissues, were given grafts of DA skin and kidney. Both host kidneys were removed. These homografts were tolerated and functioned for relatively long periods of time. To cause rejection both of skin and kidney, large numbers of competent syngeneic lymphoid cells were needed, between 2 and 5×10^8. Even with such high doses of cells, the initiation and completion of homograft destruction was unpredictable. Whole-body x irradiation with 550 R facilitated homograft rejection by syngeneic cell transfer, i.e., fewer cells were needed and graft destruction was hastened. Whole-body x irradiation per se was occasionally followed by the destruction of skin homografts. While it was impossible to determine the relative contribution made by x rays and by cells to the destruction of homografts, with x rays fewer cells were more effective. Irradiation also altered the morphology of skin transplants that were undergoing rejection. Focal necrosis of the epidermis, hair shaft epithelium, and upper dermis were noted despite a marked paucity of infiltrating cells. (BBB)

2938 EFFECT OF PENETRATION DEPTH ON RADIATION INDUCED TUMOR FORMATION IN THE SKIN OF THE ALBINO RAT. Heimbach, Richard Dean. New York, Univ. of New York, 1967. 94p.

Thesis.

The correlation between radioinduced chronic injury and tumor formation in the skin of the albino rat, and the dependence of both upon the penetration depth of ionizing radiation was investigated. An 8 cm × 3 cm area of the dorsal skin of male, albino rats was irradiated with α particles from a 40 MeV cyclotron. Groups of animals were exposed to Bragg peak depth-dose distributions of radiation with graded doses from 310 rads to 2460 rads. The penetration of the Bragg peak was adjusted so the maximum dose was delivered to the upper half of the follicles, the tips of the follicles or below the follicles. Another group of animals was irradiated with an α particle beam modified to achieve an approximately linear depth-dose having a maximum penetration of 1.09 mm with graded doses from 375 rads to 1050 rads. Loss of brown scale was the most sensitive indicator of acute radiation damage. Hair growth suppression was most marked when the Bragg peak was delivered to the tips of the follicles. Ulceration was seen only at the highest dose with the linear penetration and erythema only at the highest doses with the linear and Bragg peak penetrations. Chronic dermal damage was more severe in the linear penetration groups. Chronic interfollicular epidermal damage consisted of atrophy and was only seen over healed scars. The correlation between the incidence of abnormal hair follicles and the incidence of tumors seen in previous experiments was seen also in this work. With both linear and Bragg peak depth-dose distributions of radiation, abnormal follicle incidence and tumor incidence depended upon the minimum dose of radiation delivered anywhere along the hair follicles. This suggests that the entire length of the follicles must be irradiated to produce these effects. Their dependence upon the minimum dose of radiation delivered to the follicles can be explained by a loss of latent tumor cells, initially produced by the radiation, through a process of regenerative repair. The extent to which this repair process takes place would depend upon the extent of minimal hair follicle damage. Such a hypothesis is supported by the lack of histologically demonstrable laminar damage in the skin as well as by the independence of tumor types from the depth-dose pattern of radiation. (Disser. Abstr.) (TSS)

2939 THE QUANTITATIVE ANALYSIS OF RADIATION EFFECT OF 200 KVP X-RAYS, ^{60}Co GAMMA RAYS, 15 MV X-RAYS AND 15 MeV ELECTRON BEAMS. Koga, Mitsuru (Kyushu Univ., Japan). Fukuoka Igaku Zasshi, 59: 309-25 (Apr. 1968). (In Japanese).

The biological effects of four different radiations (200 kVp X-rays, ^{60}Co γ-rays, 15 MV X-rays, and 15 MeV electrons were studied using weight and nucleic acid of the spleen and thymus of CF_1 male mice as indicators. The spleen and thymus were taken three and a half days after irradiation, weighed, and the nucleic acid extracted, and quantitative analysis of DNA and RNA made. The values lay nearly on a straight line between 125 rads and 800 rads in semilogarithmic scale. From these data a regression line was obtained. Comparison was made on the ratio of the dose under a constant effect and the ratio of effect under a constant dose. The former calculation was made on 40%, 50%, and 60% decreases in the weight and nucleic acid contents, and the latter calculation was done on 300 rads, 400 rads, 500 rads, and 600 rads. The values for equal effect ratio of 50% effects are tabulated. The results suggest that there is a close relation between the equal effect ratio and LET. (TSS)

2940 EFFECTS OF UV RADIATION OF ABDOMINAL SKIN OF RABBITS ON HISTAMINE CONTENT OF BLOOD. Baudach, Helmut; Schreiber, Hans. Strahlentherapie, 136: 375-80(Sept. 1968). (In German).

By applying modern experimental techniques to the well known biological determination of histamine, statistically significant evidence was presented that the content of histamine within the flowing blood is increased by uv irradiation. For the first five days after irradiation the increase of histamine was directly proportional to the energy of the uv radiation. For the following time an increase of the histamine content was detectable (caused by the uv irradiation), but it was independent of energy. (auth)

2941 EFFECT OF MICROWAVES AT X-BAND ON GUINEA-PIG SKIN IN TISSUE CULTURE. 2. EFFECT OF THE RADIATION ON SKIN BIOCHEMISTRY. Carney, Shirley A.; Lawrence, J. C.; Ricketts, C. R. (Birmingham Accident Hospital, Eng.). Brit. J. Ind. Med., 25: 229-34(July 1968).

Small pieces of guinea pig skin were exposed to a uniform field of microwaves at the X-band (8730 MHz). Measurements showed that 26% of the incident energy was reflected, 34% was absorbed, and the remaining 40% was transmitted. Absorbed energy was converted to heat, causing a rise in the temperature of the skin. After exposure to microwaves the skin was maintained in vitro in a nutrient medium. Uptake of radioactive substances ($^{32}PO_4$, $^{35}SO_4$, and ^{14}C-proline) from the medium into skin constituents was measured. A graded reduction in the uptake of ^{35}S-sulfate ions into chondroitin sulfate, ^{14}C-proline into collagen, and of ^{32}P-phosphate into phospholipid, nucleic acid, and phosphoprotein fractions was found. The incident energy density causing 50% reduction of all these biochemical activities was about 4750 mJ/cm^2 under the thermal conditions of the experiment. The cooling rate of the tissue was important in determining the effect of microwaves. (BBB)

2942 ROENTGENOLOGICAL CHANGES IN THE SKELETON OF SACRED BABOONS IN PROLONGED GAMMA IRRADIATION. Simavonyan, V. G.; Dzhikidze, E. I. (Inst. of Experimental Pathology and Therapeutics, Moscow). Med. Radiol., 13: No. 7, 36-40(July 1968). (In Russian).

In three male adult sacred baboons, chronic radiation sickness was induced by prolonged daily irradiation (exposure dose 1.22 or 0.9 R, total dose 1452 R). Radiography of the skeleton in all the animals revealed dystrophic changes in the bones in the form of osteoporosis, reorganization of the bone tissue structure, diminution of the height of vertebral bodies leading to a shortening of the spine and chest, as well as constriction and deformation of the latter. Dystrophic alterations in the skeleton progressed after cessation of irradiation. (auth)

2943 MICE SUBJECTED TO THYMECTOMY AND THEIR HEMATOPOIETIC ORGANS AFTER A WHOLE-BODY X-IRRADIATION WITH A 500-R DOSE: APPROACH TO QUANTITATIVE ANALYSIS. Schneiberg, Krzysztof; Koziol-Bartnikowa, Wieslawa; Jonecko, Antoni (Inst. of Oncology, Gliwice, Poland). Postepy Hig. Med. Dosw., 22: 494-507(May-June 1968). (In Polish).

Thymectomy was performed on 58 mice 3 weeks old, and a month later they received a single 500-R dose of whole-body x irradiation. Histological studies were performed 1, 2, 3, 4, 5, and 90 days after irradiation to examine changes in the hematopoietic system. The preparatory procedure included bleeding of the mice, excision of internal and peripheral lymph nodes and spleen, and removal of marrow from the large bones. The over-all findings indicated that thymectomized mice that received sublethal whole-body x irradiation underwent more severe marrow hypoplasia than control mice. Particularly severe hypoplasia was noted in granulocyte stem cells. The tabulated data also showed how indispensable the intact thymus gland is to granulocytopoiesis in young mice. The differences were also reflected by a higher mortality rate of mice subjected to thymectomy prior to whole-body irradiation. The determinant lethal factor was evidently the agranulocytosis. Removal of thymus gland in the young mice also led to hypoplasia of lymphatic tissues, that impaired regeneration of the lymphatic system after x irradiation. (BBB)

2944 EXCRETION OF PSEUDOURIDINE IN THE URINE OF TUMOR-BEARING RATS PRIOR TO AND AFTER GENERAL IRRADIATION. Fedorov, N. A.; Bogomazov, M. Ya.; Kotov, N. N.; Pak, V. V. Byull. Eksp. Biol. Med., 66: No. 9, 86-7(Sept. 1968). (In Russian).

Experiments on 40 rats, 20 of which were inoculated with sarcoma-45, showed that the pseudouridine titer in the urine of the tumor-carrying rats remained practically unalterated. General x irradiation with 600 R provoked pseudouridinuria in exactly the same degree in the control group and in the inoculated rats. (auth)

2945 EFFECTS OF HIGH-ENERGY ELECTRONS ON MORPHOLOGICAL AND FUNCTIONAL (ERG) CHANGES IN THE RABBIT RETINA. Lommatzsch, Peter; Fuerst, Gerhard; Ulrich, Wulff-Dieter (Humboldt Univ., Berlin). Strahlentherapie, 136: 301-7(Sept. 1968). (In German).

The morphological and functional studies (electroretinogram) are reported after a single irradiation with high-energy electrons (betatron) on the eye of the rabbit. After a dose of 5000 R the first signs of lesions were noted in the ERG and in the histological sections. After 8000 R an ERG response was almost absent in all animals 10 days after the irradiation. The most sensitive layers of the retina were the outer and the inner segments of the rods. The outer nuclear layer was the next most sensitive. From 6000 to 8000 R, pycnoses in the bipolar ganglion cells were observed in the inner nuclear layer. The large ganglion cells did not show any histological changes even after 10,000 R. The evacuation of the necrotic cells seemed to occur by autolysis, as no phagocytic activity was observed. Although transposition of these findings to the clinical observations must be done with caution, it seemed that no more than 3000 R should be administered to the retina during irradiation of the orbita. (auth)

2946 STUDIES ON THE RADIATION RESPONSE OF L CELLS UNDER ENERGY DEPRIVATION. Sanders, James Lynn. Fayetteville, Ark., Univ. of Arkansas, 1968. 91p.

Thesis.

Cultured mammalian cells of the L type show a brief, accelerated uptake of radioactive precursor into both deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) following relatively low doses of 250 kVp x rays. This response appeared for cells being starved in a glucose-free salt solution and for cells treated with a 2,4-dinitrophenol. Three distinct features characterize the response: a relatively fixed postirradiation time delay seemed necessary before the accelerated labeling of the nucleic acids occurred, the labeling of the DNA fraction closely paralleled the labeling of the RNA fraction; and the radioactive label appeared to enter and then to leave both nucleic acid fractions. Although the accelerated labeling was most apparent after 100 rads, it also happened at higher doses where several cycles of incorporation and loss of label appeared. Since comparable changes were not found under normal growth conditions, this response presumably results because of the energy deprived state. Both continuous labeling and pulse labeling methods were used; the nucleic acids were labeled with either inorganic ^{32}P or radioactive precursors specific for a given fraction. Survival studies indicated that cells treated with 2,4-dinitrophenol had an increased resistance to x rays. Consequently, the radioinduced nucleic acid synthesis may represent a cellular mechanism for recovery from radiation injury. (Diss. Abstr.)

2947 INFLUENCE OF IRRADIATION BY INTERMEDIATE-ENERGY NEUTRONS ON THE CONTENT OF γ-AMINOBUTYRIC ACID IN THE CEREBRAL CORTEX. Malashko, V. I. (Inst. of Physiology, Minsk). Radiobiologiya, 8: 622-3(1968). (In Russian).

Sexually mature white rats were irradiated on the biological channel of a reactor with intermediate-energy neutrons at a dose of about 13.5 rad, and the total γ-aminobutyric acid (GABA) content in the cerebral cortex was determined on the first and sixth days after irradiation. It was established that under the influence of the neutron dose used, there were phase changes in the GABA content in the cerebral cortex, expressed in a certain tendency for an increase in the level of GABA during the first day and a substantial decrease on the sixth day after irradiation. (JPRS)

2948 STRUCTURAL CHANGES OF THE RABBIT RETINA FOLLOWING X IRRADIATION. Lommatzsch, P.; Klug, H.; Hemke, St. Arch. Klin. Exp. Ophthalmol., 170: 16-29(June 2, 1966). (In German).

The effects of x irradiation on the rabbit retina were studied histologically and with the electron microscope. The heads of the animals were irradiated with a single dose of 10,000 R of 184-kV x ray, administered over a period of 48 min. The retinas were examined immediately after the animals were killed at postirradiation intervals of two hr, and at one, three, or seven days. There was prominent swelling of the interlamellar regions of the outer and inner segment of the rods. These components and the nucleus of the first neuron were the most radiosensitive parts of the retina. (BBB)

2949 ACTION OF X RAYS ON NERVE ELEMENTS OF THE CORNEA. Emilit, V. A. (Pavlov 1st Medical Inst., Leningrad). Oftal'mol. Zh., 21: 454-8(1966). (In Russian).

Forty female cats (wt 2.5 to 3.5 kg) received a single local dose of 700, 1000, or 2000 R of x irradiation after intraperitoneal urethane injection in a 0.6 to 0.7 g/kg dose. The cats either died or were killed by chloroform narcosis, within hours to four months after irradiation. Their eyes were enucleated and preserved in 12% neutral formalin for various studies and comparison with the condition of the shielded left eyes and with the eyes of nonirradiated cats. Irradiation induced morphological changes of the corneal nerve elements as seen within the first postirradiation days. Manifestations of radioinjury ranged from slight changes in the corneal nerve fibers to total destruction of the nerve elements. Reversible regressive changes of nerve fibers and later regeneration effects were seen in some cats. Changes of the nerve elements were mainly observed in the periphery of the cornea, especially in the area of large medullated fibers. Changes in the corneal nerve fibers resulting from x radiation closely resembled uv-radioinduced changes affecting the eye, except for the time of appearance and intensity. Generally, radiation effects in the peripheral nerve system show no specific reaction pattern. The observed injuries caused by the 700-R x-ray dose to the neural elements of the cats' corneas were, by comparison, more severe than the same dose produces in other animals, which is attributed to the differential sensitivity of various animal species to x-ray exposure. (BBB)

2950 CHANGES IN HIGHER NERVOUS ACTIVITY OF RHESUS MONKEYS INDUCED BY A TOTAL GAMMA IRRADIATION. Khasabova, V. A. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Zh. Vyssh. Nerv. Deyateln. Im. I. P. Pavlova, 17: 730-8(1967). (In Russian).

The effect of whole-body doses (60, 100, and 400 R) of γ radiation on food-motivated conditioned motor reflexes was studied in seven adult monkeys (Macaca mulatta). The 400-R dose induced phasic changes of conditioned activity. The first phase, the primary disturbance in conditioned activity, did not depend on hematological changes and lasted from one to four days. The second phase, of relative normalization and stabilization of the conditioned reflexes, proceeded against the background of a progressively developing irradiation disease and lasted from 11 to 18 days. The third phase, of secondary changes in conditioned reflexes, lasting from 7 to 16 days, continued even after normalization of the blood parameters (when the animals survived). Single whole-body irradiation doses of 60 and 100 R resulted in a disturbance of conditioned activity that lasted about two weeks.

Possible explanations for these phasic variations in conditioned reflex intensity are proposed. (BBB)

2951 LATE EFFECTS OF WHOLE-BODY IRRADIATION ON NUTRIENT DIGESTIBILITY BY THE BURRO. Knapka, J. J.; Barth, K. M.; Brown, D. G. (Univ. of Tennessee, Oak Ridge). J. Anim. Sci., 27: 656-9(May 1968).

Since irradiation damage may be related to the aging process, attempts were made to establish a possible effect of age on nutrient digestion in nonirradiated burros. A total fecal collection trial involved ten-12-yr-old burros averaging 200 kg in body weight, five of which were nonirradiated and five which survived seven yr after exposure to a single 500-R dose of whole-body γ irradiation from a $^{95}Zr-^{95}Rb$ source. These burros were also fed 3.63 kg per day of a well defined diet. Nutrient digestion was determined, using polyethylene as an external indicator, in 3-yr-old burros, four nonirradiated and four that were exposed to a single 250-R whole-body dose of γ radiation from a ^{60}Co source at about 4 months of age. The first trial, designed to determine the effect of age on nutrient digestion, indicated that the three-yr difference in age did not significantly affect digestion of organic matter, crude protein, ether extract, crude fiber, or nitrogen-free extract. The results of the other trials that compared digestion of irradiated and nonirradiated burros indicated that there were no significant differences in the digestion of proximate nutrients as a result of irradiation. However, irradiated burros consistently digested less crude fiber than nonirradiated burros. (BBB)

2952 IMMUNOLOGICAL REACTIVITY OF RADIATION CHIMERAS. II. ROLE OF THE HEMATOPOIETIC DONOR TISSUE IN ANTIBODY FORMATION. Kaulen, D. R. (Inst. of Epidemiology and Microbiology, Moscow). J. Hyg. Epidemiol. Microbiol. Immunol., 12: 122-9(1968).

The immune response to diphtheria toxoid and typhoid vaccine of radiochimeras (guinea pigs irradiated with absolute lethal doses, 600 to 650 R, and transplanted with homologous bone marrow and spleen cells) was studied. It was demonstrated that for 50 days after irradiation the formation of diphtheria antitoxin was a function of the donor cells. This applied to the transplantation of spleen cells both from normal animals and from presensitized animals. In the latter case, antitoxin formation was of the secondary reaction type. It was demonstrated that donor cells were present in the recipient and retained their immunological function, i.e., their capacity for a secondary reaction for 30 days. The degree of antibody formation was greatest when immunization was begun on the day of transplantation and diminished as the interval between transplantation and administration of antigen increased. Under the experimental conditions used, spleen homogenates from immunized donors were unable to transfer immunological competence to irradiated recipients. (BBB)

2953 EFFECT OF LOCAL IRRADIATION OF THE KIDNEYS ON THE RENAL FUNCTION OF THE DOG. Zaruba, Karel (Charles Univ., Hradec Kralove, Czech.). Radiat. Res., 35: 661-7(1968).

Renal function after bilateral single-dose x irradiation of the kidneys of dogs with 600, 1600, and 2400 R showed no marked changes. The values of the functions were within physiological limits in most cases. It may thus be judged that changes in the renal function in radiation sickness are not due to the direct effect of radiation on renal tissue. (auth)

2954 ESTIMATION OF DEOXYCYTIDINE IN URINE OF HUMANS AND LABORATORY ANIMALS. Shejbal, J.; Arient, M.; Kovarikova, H. (Charles Univ., Prague). Clin. Chim. Acta, 16: 324-5(1967). (In Czech).

Acidified urine was passed through a column of Dowex 1-X8 resin and then through a column of Dowex 50W-X8, on which deoxycytidine (I) was retained. Fractional elution was made with ammoniacal ethanol, and the eluate fractions were evaporated to dryness. The residues were dissolved in H_2O and subjected to chromatography on Whatman No. 3 paper, with butanol–H_2O (21 : 4) as solvent and aq. NH_3 in the bottom of the tank. The I spots were detected in u.v. radiation and extracted with H_2O, and the I was determined microbiologically by the growth of Lactobacillus acidophilus R26. Results are given for normal human excretion and for that of rats, mice, and dogs. Increased excretion was observed as a result of irradiation with x rays. (Anal. Abstr.)

2955 EFFECT OF ERYTHROPOIETIN ON GROWTH AND DEVELOPMENT OF SPLEEN COLONY-FORMING CELLS. Schooley, John C. (Univ. of California, Berkeley). J. Cell Physiol., 63: 249-62(Dec. 1966).

The progressive growth and development of spleen colonies were studied in heavily irradiated host mice in which erythropoiesis was modified by various procedures. Female C_3H Cum mice were irradiated with ^{60}Co γ-ray doses of 872 to 960 R (air). Immediately after irradiation the groups of mice were injected intravenously with 0.5 to 1.0×10^5 viable bone marrow cells from isologous donor mice. Erythropoietic activity in nonpolycythemic hosts bearing spleen colonies was not increased by injections of exogenous erythropoietin. Erythropoietin was found in the heavily irradiated host mice suggesting that the failure of exogenous erythropoietin to modify erythropoiesis was because the host mice were already maximally stimulated by the high endogenous erythropoietin levels. Spleen colonies did not become erythroid in polycythemic mice. Injection of exogenous erythropoietin into heavily irradiated polycythemic hosts did not decrease the total number of spleen colonies produced by a given bone marrow transplant, as would be expected if erythropoietin acted directly on the colony-forming cells. Comparison of growth curves for colony-forming cells in the spleens of polycythemic hosts either receiving or not receiving erythropoietin indicated that the overall doubling time of colony-forming cells during the first 10 days after transplantation was not changed by daily injection of erythropoietin. Erythropoietin is evidently necessary for the development of erythroid colonies, and acts upon some progeny of the colony-forming cell rather than the colony-forming cell itself. (BBB)

2956 THE ELECTROPHORETIC PROPERTIES OF PARTICLES OF SOME MODEL COMPOUNDS AND BIOLOGICAL CELLS AND THE EFFECT OF SMALL DOSES OF IONIZING RADIATIONS ON GRAPHITE IN SUSPENSION: THE EFFECT OF TRITIATED WATER AND A RADIOACTIVE DRUG ON HUMAN RED CELLS AND EHRLICH ASCITES CARCINOMA CELLS. Mehrishi, J. N. (Addenbrooke's Hospital, Cambridge, Eng.). Indian J. Cancer, 4: 304-18(Sept. 1967).

Cyclical variations were noted in the mobilities of particles of graphite, seen as a series of maxima and minima, after exposure to small doses of x rays. The electrophoretic mobilities of particles (1 to 3 μ dia.) of n-octadecylamine (and its acetyl, benzoyl, and tosyl derivatives), arachidic acid, and stearic acid suspended in aqueous solution of sodium chloride were also measured at 25°. The large positive value of the electrophoretic mobility of n-octadecylamine was attributed to the amine group; it was observed to fall to zero on benzoylation. The electrophoretic behavior of acetyl, benzoyl, and tosyl derivatives of n-octadecylamine provided evidence in support of the view that the amine group of the parent amine is responsible for the positive electrophoretic mobility. The effect of addition of small amounts of 2-methyl-6,7-ditritio-1,4-naphthaquinol bis disodium phosphate (commercial name, TRK 219) on the electrophoretic mobility of human erythrocytes and Ehrlich ascites tumor cells suspended in saline at pH 7.2 and 10.4 was also examined. The selective uptake of the tritium label of TRK 219 by the tumor cells was demonstrated but there was no significant change in the electrophoretic mobility of the cells under these conditions (dose range of 30 to 142 rad). (BBB)

2957 TELENCEPHALIC COMMISSURES IN THE CYCLOCEPHALIC MOUSE FETUS. Auroux, M.; Roussel, C. (Faculte de Medecine, Paris). Arch. Anat. Histol. Embryol. Norm. Exp., 49: 537-56(1966). (In French).

Anomalies were induced in fetal mouse brains by treatment of the mothers with x rays or large doses of vitamin A. Telencephalic commissures were studied in three cyclocephalous fetuses that were produced that presented different degrees of malformations. The anterior commissure was absent in typical cyclocephaly. Owing to the fact that the corpus callosum was absent, the anterior commissure seemed to recover its former interneopallial cortex functions. The fornix commissure was represented in three brains studied by a voluminous transversal commissure that connected the posterior parts of hippocampal areas. The corpus callosum was also absent in typical cyclocephaly. In two slight cases, it was represented by its bilateral preliminary shapes, and the true commissure was never obtained: the fibers did not go through the median line. The nature of the barrier is discussed. The fact that, in different abnormalities such as corpus callosum agenesis and cyclocephaly, corpus callosum may be supplied by the anterior commissure indicates the general character to this substitution. The total absence of a commissural system may be related to a defect of cortical histogenesis. (BBB)

2958 COMPARISON OF THE EFFECTS OF IONIZING RADIATION AND RADIOMIMETIC DRUGS ON THE INTESTINAL EPITHELIUM. Hampton, James C. (Northwestern Univ., Chicago). Atti Accad. Med. Lombarda, 21: 193-9(July-Sept. 1966).

When mice were exposed to 3 Krad of x irradiation, cell proliferation was blocked and DNA synthesis ceased for a few hours. The cells could then undergo one or two synthetic phases without mitosis. At the three to five day postirradiation interval, intestinal villi were short and often denuded and crypts were short

and lined with abnormal cells. The possibility was tested that radiation effects were not limited to inhibition of cell proliferation and that postmitotic cells might also be damaged. Colchicine was given in four daily injections to mice to bring about sustained mitotic arrest. The results showed that although the proliferative compartments of the crypts were nearly destroyed, the villi did not show the extreme shortening obtained with x rays nor did villus cells develop degenerative cytologic changes. Thus, it appeared that mitotic arrest was not an acceptable explanation for epithelial loss at three to five days postirradiation with 3 Krad of x rays. With nitrogen mustard, that more closely mimics radiation effects on cells than colchicine since it is known to arrest cell proliferation in G2 phase of the generative cycle as do x rays, the results were quite comparable to those obtained with x irradiation. It was suggested that x rays and nitrogen mustard interfered with some stage of nucleic acid replication and/or protein synthesis. (BBB)

2959 CHANGES INDUCED IN THE SELF-SELECTED CIRCADIAN RHYTHM OF THE CANARY BY TRIIODOTHYRONINE AND ^{131}I. Wahlstrom, Goran (Univ. of Uppsala). Acta Pharm. Toxicol., 25: Suppl. 4, 72(1967).

The effect of ^{131}I and thyroid hormone on the self-selected circadian rhythm recorded in canaries kept singly in lightproof cages was determined. The light inside the cage (an ordinary lamp) was regulated by a perch. When the bird hopped onto this perch the light went out and when it left the perch the light was turned on. The canaries could thus choose between light and darkness. Several treatments of the same bird with ^{131}I gradually caused a decrease in activity, an increase in rest, and a decrease in the circadian period. Triiodothyronine (6 to 10 mg/Kg orally) given as a single dose late in the activity to birds previously treated with ^{131}I caused an increase in the circadian period similar to that in normal birds though more marked. The increase could be traced over nine to 10 periods after administration. Triiodothyronine (6 to 10 mg/Kg orally) administered alone as a single dose to normal birds during activity caused an increase in activity and a decrease in rest with a maximal response in the first period after the administration. The circadian period was also increased with a maximum in the first period. The results indicate that the thyroid has an effect on the length of the self-selected circadian period. The positive effect was a longer circadian period. (BBB)

2960 RETAINING APPARATUS FOR UNILATERAL UTERINE IRRADIATION OF THE PREGNANT MOUSE. Grueninger, Helmut (Univ., Tuebingen, Ger.). Strahlentherapie, 136: 381-3(Sept. 1968). (In German).

A box, made out of lucite and lead in varying thicknesses, is described. It is suitable for restraining mice for unilateral uterine irradiation. (auth)

2961 REACTIVITY OF ANIMALS SURVIVING AFTER ACUTE RADIATION SICKNESS AS A RESULT OF SHIELDING OF PART OF THE BONE MARROW AND SUBSEQUENT AUTOTRANSPLANTATION OF IT INTO THE BLOODSTREAM. Kozlova, N. V.; Shmidt, N. K. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya, 8: 628-30 (1968). (In Russian).

The reactivity of rats surviving after acute radiation sickness was studied. It was found that an organism irradiated at a lethal dose and saved by shielding part of the bone marrow (the femur), followed by autotransplantation of it into the bloodstream, despite the disappearance of symptoms of radiation sickness, actually is not entirely effective and manifests its inadequacy even a substantial period of time after the influence of ionizing radiation (seven months). Its resistance is lowered, as is the reactivity of the lung tissue to the action of urethane. In the case of intraperitoneal injection of urethane into rats, death of the irradiated animals as a result of pronounced pathological changes in the lungs soon results. In this case, the nonirradiated animals do not die, and they show no pathological changes in the lungs. (JPRS)

2962 ACTION OF IONIZING RADIATION ON Mg METABOLISM. Guenther, Th.; Bublitz, G. (Freie Univ., Berlin). Z. Klin. Chem. Klin. Biochem., 6: 262-5(June 1968). (In German).

The distribution of Mg in the male Wistar rat was studied after irradiation with a single whole-body dose of 1000 R from ^{60}Co. Four days after irradiation the Mg concentration was increased in serum and liver. There was essentially no change in the concentration of Mg in the muscle. The Mg concentration in serum started to rise on the third day after irradiation. As the level of serum Mg increased, the urinary Mg concentration decreased. The administration of increased amounts of Mg had no influence on the survival period of whole-body irradiated rats. It was considered unlikely that Mg was involved in the metabolic changes caused by irradiation. The increased permeability of the cell membrane after irradiation might account for the rise in serum Mg. (BBB)

Man

Refer also to abstracts 2750, 2763, 2771, 2839, 2843, 2875, 2881, 2883, 2885, 2886, 2892, 2893, 2895, and 2954.

2963 (RLO-1780-23) EFFECTS OF IONIZING RADIATION ON THE TESTICULAR FUNCTION OF MAN. Heller, Carl G. (Pacific Northwest Research Foundation, Seattle, Wash.). Mar. 1968. Contract AT(45-1)-1780. 93p. Dep. CFSTI.

Application of known doses of ionizing radiation directly to the testes of normal men was carried out and investigated at the cellular and hormonal levels. Detailed discussions of the results are presented. (B.S.L.)

2964 (TT-67-56003/4) POLISH REVIEW OF RADIOLOGY AND NUCLEAR MEDICINE. Translated reprint of Pol. Przegl. Radiol. Med. Nukl., 31: 481-635(1967). 162p. CFSTI.

Papers within the scope of NSA were abstracted from the original language and appeared in previous issues. (H.G.D.)

2965 (UCRL-Trans-10173) LOCALIZATION OF CHANGES IN THE ELECTRICAL EXCITABILITY OF THE VISUAL APPARATUS DURING DARK ADAPTATION. Akimochkina, V. A. Translated by S. R. Silcock for Univ. of California, Lawrence Radiation Lab., Livermore, from Probl. Fiziol. Opt., 1: 125-7(1941). 8p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

A fall in the electrical excitability of the visual apparatus during dark exposure was confirmed. In order to study the localization of these changes, observations on 21 patients all of whom had undergone enucleation operations were made. In the majority of cases the electrical excitability of the enucleated side fell during dark adaptation. When conditions of light adaptation were restored (i.e. those for the uninjured eye), the electrical excitability of the operated side was increased. On both the enucleated and uninjured sides, the changes in the electrical excitability followed parallel courses. The findings point to a central origin for changes in the electrical excitability of the visual apparatus owing to light and dark exposure. (auth)

2966 (UCRL-Trans-10174) ELECTRICAL SENSITIVITY OF THE EYE BEFORE AND AFTER ENUCLEATION. Bogoslovskii, A. I.; Ivanova, E. M. Translated by S. R. Silcock for Univ. of California, Lawrence Radiation Lab., Livermore, from Probl. Fiziol. Opt., 1: 129-36(1941). 22p. Dep. CFSTI. JCL $2.60 fs, $1.10 mf.

Electrical sensitivity thresholds were determined before and after enucleation in twelve patients. The patients were left for 20 min in low illumination (1 to 2 lux), after which dark adaptation was carried out (20 to 50 min), and subsequently light adaptation to brightness of about 500 lux. Throughout the experiment the enucleated eye was kept darkened. In those cases where prior to enucleation the clinical picture showed the retina to be in comparatively good condition, with the optic nerve functioning normally, the thresholds of electrical sensitivity and the latter's adaptive changes for the affected eye approached those of the healthy eye. Thus the sensitivity was close to normal, with a rapid fall of sensitivity in the dark and a rapid increase in light. In cases where prior to enucleation there was significant retinal detachment, giving rise to organized exudation and hemorrhage, or if the retina was almost entirely absent, electrical sensitivity of the affected eye was markedly decreased, and adaptive changes were disturbed; only with prolonged dark exposure was a comparatively small decline obtained with dark adaptation. In cases where prior to operation the retina was more or less intact, a marked drop in the sensitivity and disturbance of adaptive changes occurred after the operation; however, when the retina was severely damaged or absent altogether, the picture of the electrical sensitivity remained the same as before the operation. Thus it was demonstrated that with threshold electrical stimulation of the healthy eye, the first impulse arises in the retina; adaptive changes in electrical sensitivity under normal conditions can be explained only by the combined action of visual centers and the retina. (H.L.W.)

2967 (UCRL-Trans-10187) EFFECT OF HELIOPHYSICAL FACTORS ON BLOOD CELL COMPOSITION. Ryvkin, B. B. Translated by S. R. Silcock for Univ. of California Lawrence Radiation Lab., Livermore, from Probl. Gematol. Pereliv. Krovi, 11: 24-5(1966). 5p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The effect of solar activity on the cellular composition of blood was studied in apparently healthy individuals and in patients not suffering from diseases of the blood. During the observation pe-

riod there were 32 days with frequently occurring leukopenia, 27 of these were days with high solar activity. An increase of the number of persons with leukopenia was observed both at the date of high solar activity and the subsequent two to three days. Comparison of the leukopenia incidence dynamics and of the monthly solar activity indices indicated a statistically authentic correlation between them. (auth)

2968 CARCINOGENIC EFFECTS OF SOLAR RADIATION AND PREVENTION MEASURES. Freeman, Robert G. (Baylor Coll., Houston, Tex.). Cancer, 21: 1114-20(June 1968).

It is well known that exposure to the sun is the major cause of cancer of the skin—the most common type of cancer encountered in this country. Little is known about the wavelengths responsible for this carcinogenic effect except that it is composed of the shortest wavelengths (290 to 320 mμ) of the solar spectrum. More quantitative information is available about wavelengths and energy requirements for induction of erythema by sun exposure. This may be pertinent to the cancer of the skin problem if it is assumed that erythema represents an early injury that ultimately develops into cancer of the skin. Protection of the individual's skin from sun exposure is the most effective preventive measure now available. This includes avoidance of intense mid-day exposure and use of topical sunscreen preparations when prolonged exposure is unavoidable. A protective effect was demonstrated with some systemically administered agents but their use is not yet practical. Evidence that solar-induced erythema, degeneration, and premalignant changes are reversible gives hope that more effective cancer preventive measures may become available for the patient with severe actinic damage. (auth)

2969 CASE OF CONSECUTIVE OSTEOSARCOMA FOLLOWING REPEATED IRRADIATIONS. Merle, P.; Rampon, S.; Plagne, R.; Defouilloux, B. J. Radiol., Electrol., Med. Nucl., 49: 422-4 (May 1968). (In French).

A case of osteosarcoma of the upper extremity of the right humerus, that was apparently the result of x-ray therapy of the right shoulder, was reported. It was estimated that over a period of 2½ years the patient received a total dose, measured at the skin, of 10,200 R. The rarity of sarcomas induced by radiotherapy appears sufficient reason to continue radiotherapy when other indications are positive. (J.S.R.)

2970 CHROMOSOME DAMAGE INDUCED BY PLASMA OF X-RAYED PATIENTS: AN INDIRECT EFFECT OF X-RAY. Hollowell, Joseph G. Jr.; Littlefield, L. Gayle (Medical Coll. of Georgia, Augusta). Proc. Soc. Exp. Biol. Med., 129: 240-4 (Oct. 1968).

The difference between the direct effects of x rays on leukocyte chromosomes and the indirect effect transmitted by blood plasma was investigated. Plasma from irradiated and nonirradiated tumor patients was added to normal lymphocytes and cultured. The cells were then examined for chromosome aberrations and the mitotic indexes were measured. The frequency of chromatid breaks after treatment of cells with plasma from irradiated tumor patients was higher than that from cells using normal plasma or plasma from nonirradiated patients. The mitotic index showed no significant differences in the groups studied. The presence of a chromosome-breakage factor in the plasma of x-irradiated patients was postulated and discussed. (F.M.M.)

2971 SENILE ACTINIC ELASTOSIS. Braun-Falco, O. (Philipps-Univ., Marburg a. d. Lahn, Ger.). Dermatol. Int., 4: 232-7(Oct.-Dec. 1965). (In German).

Senile or actinic elastosis is not related primarily to age, but to intensity and duration of prolonged exposure to sunlight, together with absence of melanin. Exposure of dermal collagen to uv irradiation leads to profound changes of the soluble collagen fraction. Typical changes observed after exposure consist initially of loss of the subepidermal elastic plexus. This is followed by proliferation of round or membranous elastic stainable fibers. Intensive changes that follow these consist of a degeneration process, with transition to grossly stratified masses, known as colloid. The term colloidal degeneration is applicable to this condition. The question whether actinic elastosis represents a change in collagenous or elastic fibers has not been resolved so far. Many findings indicate a very close relation between the elastotic material and the normal elastic fibers. The fiber convoluate of actinic elastosis resembles normal elastic fibers, because they have the same refractility, do not swell in dilute acids or bases, have the same self fluorescence, and are not double refracting. (BBB)

2972 INFLUENCE OF IONIZING IRRADIATION UPON CHROMOSOME OF HUMAN LEUCOCYTE. Sasaki, Taro (Niigata Univ., Japan). Nippon Sanka Fujinka Gakkai Zasshi, 20: 631-40(June 1968). (In Japanese).

The somatic effects of ionizing radiation upon peripheral leukocyte chromosomes was investigated in connection with the treatment of uterocervical cancer cases. Centrotherapic ^{60}Co γ irradiation and ^{60}Co teletherapy were used for treatment and the chromosomes were examined before the treatment, just after treating, three months, six months, one year, two years, and three years after treatment. The chromosomes showed abnormalities compared with healthy men. The unstable abnormal cells tended to be decreased with the lapse of years while the stable ones remained for a long time. Among seven nuclear types (A-G) of chromosome groups, abnormal fragmentary chromosomes produced by irradiation were distributed in A, B, and C groups. In relation to the methods of ionizing radiation therapy, the abnormal cells tended to increase, more tele ^{60}Co plus ^{60}Co vaginal or uterocervical irradiation group than in tele ^{60}Co independent irradiation group. But noticeable differences were not observed later than six months after irradiation. As for the investigation concerning the relation between peripheral blood and the time elapsed, the decrease of leukocytes was maximum at three months after irradiation and after that, recovery was recognized. Differing from blood inspection, however, the chromosomes kept showing heavy lesions in peripheral lymph cells for a long period. (NSA of Japan) (TSS)

2973 CONCENTRATION OF FREE AMINOACIDS IN THE BLOOD AND THE URINE OF PATIENTS UNDERGOING RADIOTHERAPY. Tyutin, L. A. (Leningrad Military Medical Academy). Med. Radiol., 10: No. 13, 21-6(1968). (In Russian).

In order to study more thoroughly protein metabolism in cancer patients undergoing radiotherapy, paper chromatography was used to determine concentration of free amino acids in the whole blood of 120 patients and in the urine (24-hour sample) of 90 patients (all exposed). Analyses were performed prior to exposure of all patients and then at the end of the radiotherapy course; in the case of a few patients analyses were performed during the course of radiotherapy. Fifty patients were exposed post-operatively, and 70 females were treated for cervix carcinomas by a combined method. To 20 females from this group, cystamine hydrochloride was administered, while 20 other females were receiving a vitamin complex (B group) and vitamin C. In patients of all groups undergoing radiotherapy, an increase in concentration of the majority of free amino acids in blood and urine was observed. A higher level of amino acids in blood was more marked by the end of the radiotherapy course. An increase in urinary secretion of some amino acids was recorded following exposure of the patients to a relatively low dose of irradiation, provided radiation injury did not develop. A change in the level of a number of amino acids in the blood and urine of patients who received cystamine and the vitamin complex was less pronounced than in patients from other groups. (auth)

2974 ISOTOPE EVALUATION OF THE EFFECT OF MICROWAVES ON CAPILLARY CIRCULATION IN MUSCLES OF THE EXTREMITIES. Gorski, Szczesny; Kwasniewska-Blaszczyk, Marcelina; Mackiewicz, Stefan; Ramlau, Danuta (Balneoclimatic Sanatorium, Poznan, Poland). Pol. Tyg. Lek., 22: 940-3(June 19, 1967). (In Polish).

Studies are reported on 30 subjects (28 females, two males), aged 17 to 67 yr, divided into three groups, each of whom received 0.1 ml of ^{131}NaI (5 μCi) isotonic solution injected 3 cm deep into the gastrocnemius muscle, and scintiscanning was done above the injection point. The site was exposed to microwave energy at 2425 MHz frequency (12.4 cm wave-length) for three min, seven min, or 15 min. For evaluation of the radiation effects on the capillary circulation in the gastrocnemius muscle, the following parameters were examined: circulation at rest, circulation after exposure, reaction time, and reaction retardation time. Depending on the duration of microwave radiation, the irradiated area showed at a 3-cm depth either hyperemia, ischemia, or no reaction at all, as seen by the disappearance rate of the locally injected ^{131}I. A three-min exposure had no effect on the capillary circulation, a seven-min exposure increased capillary activity by 25%, and 15-min irradiation resulted in a 46% increase of the capillary circulation. The groups showed different values for the latent period and duration of response. The earliest appearing reaction was seen within the 1st min after switching on the microwave generator, and the longest delay time for the capillary reaction was 15 min. Positive and negative irradiation responses were seen, most with a one-phase course of action, but sometimes with a two-phase, and, in one case, a three-phase reaction was observed. (BBB)

2975 EFFECT OF UV RAYS ON THE CELLULAR RESPONSE DETERMINED BY THE REBUCK METHOD. Stolzmannowa, Helena; Orlowska-Sawionek, Irena (Inst. of Immunobiology, Poznan, Poland). Pol. Tyg. Lek., 22: 963-4(June 19, 1967). (In Polish).

Investigation included 17 female and 11 male subjects, aged

23 to 60 yr, without evident hematopoietic disorders. Skin of the frontal part of the shin was sterilized with alcohol, then a 16 mm^2 area was scarified, and covered with a sterile glass plate and sterile bandage. Simultaneously both shins were abraded at corresponding sites, thus enabling the left shin to serve as a control. About two hr prior to scarification, the skin of the right shin received uv irradiation over a total area of 9 cm^2. The experiment lasted 24 hr. At two, four, six, eight, 12, 14, and 24 hr the glass plate was replaced, air-dried, stained, and examined to evaluate the composition of the cellular exudate. Usually, the cells discharged first appeared between the second and the fourth hr, and consisted mostly of polymorphonuclear leukocytes, as well as mononuclear macrophages, among the 2000 to 3000 cells counted per plate. Granulocytes were much larger than those circulating in the blood, while acidophilic cells appeared very often in these skin windows tests after uv irradiation. The findings indicated that the uv irradiation failed to modify the cellular exudation response. (BBB)

2976 A CASE OF ELECTRON RADIATION BURN DUE TO AN ELECTROSTATIC ACCELERATOR. Morikawa, Susumu; Kimura, Kishio; Ono, Yamayasuhito; Kawakachu, Noboru; Oota, Susumu (Kyoto Univ.). Rinsho Hoshasen, 7: 125-35(Feb. 1962). (In Japanese).

A male technician, 27 years old, was exposed to an intense β-ray beam for a short time. The radiation effects and clinical observations are reported. Both hands and the right leg were exposed to doses of 1.2×10^4 to 11.3×10^4 rad in 2 sec. The electron energy was considered to be between 0.5 and 1.3 MeV. The lesions were restricted to the skin but severe changes covered a wide area. No systemic effect was observed. The burns were considered to be first to second degree in severity, and different from heat burns in view of the late occurrence of symptoms and chronic nature of the lesions. The changes in skin were similar to those seen with x-ray burns but the extent of the lesions was different. Changes in the burns from β-ray exposure could be divided into four periods. First was the latent period, i.e., the first week after exposure when there were no obvious symptoms. The second period was the formation of erythema and blisters, from eight to 10 days after exposure. There were inflammation, light pain, and swelling in the local skin areas. By 15 to 17 days vesication started; pain was decreased with the appearance of vesication and it lasted for one to two weeks. After that, the vesicles dried and became purulent in some areas. Alopecia was observed in a later period. The third was the recovery period, from five to six weeks after exposure. The regeneration of epithelial tissues was observed in the affected skin. Fourth was the chronic period: about two months after exposure, the regeneration of epithelial tissues was complete but there were atrophy, discoloration, and keratinization in affected skin. (BBB)

2977 LEUCOCYTE RESPONSE TO PORTAL IRRADIATION. Kettunen, Kalevi (Maria Hospital, Helsinki). Ann. Med. Intern. Fenn., 56: 125-6(1967).

Short-term portal 200-KV x irradiation resulted in marked leukocytic depression in the first week but during the course of treatment the cell counts leveled off, as resistance was acquired at the end of first week of irradiation. The study was based on blood cell counts of 65 females with breast cancer who received postoperative radiotherapy three weeks subsequent to radical mastectomy. Treatment lasted three weeks and blood samples were drawn weekly. Two fields were treated daily. The daily dose was 300 R measured at the skin, the total cutaneous dose for each field being 5000 R. The regression curve derived from daily observations was $y = 3486 \times 10^{0.24656/x}$, where y = leucocyte count (cells/mm^3) and x = time (days). The individuals received local irradiation in areas where little or no hemopoietic tissue was located. The relatively low doses of scattered radiation received by the marrow and lymphatic tissue outside the port seemed unlikely to be a major factor in leukocyte depression. Irradiation might produce sequestration of circulating leucocytes into the tissues. Thus, the underlying mechanism for disproportionate leucocyte response would be the destruction of leucocytes in the areas exposed to fractionated radiation. (BBB)

Radiation Effects on Plants

Refer also to abstracts 2740, 2808, 2810, 2811, 2813, 2815, 2816, 2919, 2995, 3003, and 3008.

2978 (CEA-R-3509) CONTRIBUTION TO THE STUDY OF THE EFFECT OF A LOW DOSE OF GAMMA IRRADIATION ON SEEDS AND TUBERS BEFORE PLANTING. Silvy, Andre (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). May 1968. 39p. (In French). Dep.

From 1962 to 1965, 25 tests were made with carrots, radishes, spinach, tomatoes, potatoes, barley, rice, and corn, with the object of studying the agricultural interest of seed and tuber γ irradiation at low dose before planting. These tests were made in the laboratory, in greenhouses, and in the open field. Special attention was paid to the homogeneity of plant material by controlling moisture content of seeds and the storage conditions of tubers. The observations concerned germination, growth at early stages, development phases, and yield of leaves, roots, and fruit. For tomatoes, it was found that stimulation occurred at extreme moisture content and not in the range of mean moisture content that corresponds to maximum radioresistance. The demonstration of these effects was related to varieties, complementary treatments, conditions of cultivation, and observation criteria. In most cases, they were short-lived and suitable modifications of seed conditioning produce, upon controls, an effect equivalent to that of irradiation. It seemed unlikely, considering our cultivation methods, that seed and tuber irradiation before planting could be of interest for agriculture. (auth) (TSS)

2979 USE OF IONIZING RADIATION IN CORN BREEDING. Musiiko, A. S.; Klyuchko, P. F. Dokl. Vses. Akad. Sel'skokhoz. Nauk, 1: 9-13(Jan. 1966). (In Russian).

Tests were started in 1958 to examine the feasibility of irradiating corn seeds before sowing, in order to improve the selection and to increase the yield. A number of varieties and hybrids of varying degrees of viability, grain consistency, biochemical composition and other properties were used for the tests. The seeds were irradiated 1 to 2 months before sowing with 500 to 50,000 R of γ radiation or with 6×10^7 to 10^{13} n/cm^2 of neutron radiation. In order to determine also the delayed effects, on the exposed seeds, the first and subsequent generations from the cross-pollinated plants were sown directly, without a repeated irradiation. The tests included phenological observations, taking into account smut-induced injury to the plants, general appearance, height and the qualitative and quantitative evaluation of the yield. As a result of the repeated selection of irradiated seeds, lines with high albumin content and self-pollination were developed; the desirable properties were conserved after repeated self-pollinations. The results indicated that ionizing radiation is best used in conjunction with hybridization and other selection methods, in order to increase the yield of the albumin content of the seed and generally to improve the properties of corn. (TTT)

2980 INFLUENCE OF THE POST-IRRADIATION TREATMENT OF BARLEY SEEDS WITH LOW CONCENTRATIONS OF ETHYLENIMINE ON THE PHYSIOLOGICAL EFFECT OF THE RADIATION. Orav, T.; Shangin-Berezovskii, G.; Orav, I. Eesti NSV Tead. Akad. Toim., Biol., 17: 20-8(1968). (In Russian).

Barley seeds of the Khar'kovskii 306 variety grown in Moscow and Estonia were exposed to doses (6 and 8 kR) of x rays and then treated with a 0.01% aqueous solution of ethylenimine for four hrs. The effects of ethylenimine were similar in both irradiated and nonirradiated plants and did not depend on the origin of the seeds (lengthening of spikes, increase in plant height). Ethylenimine increased radiation damage (e.g., increase of the spike length/spike width ratio); modifications of effects of ethylenimine treatment depended on the biological peculiarities of the treated seeds owing to different geographical origin (lengthening of the vegetative period in plants grown from Moscow seeds but not from Estonian seeds). (auth)

2981 GROWTH OF CORN SEEDLING ROOT CELLS IRRADIATED WITH HIGH X-RAY DOSES. II. CELL GROWTH WITH A COMPLETE BLOCKING OF MITOSES. Ivanov, V. B. (Inst. of General and Inorganic Chemistry, Moscow). Tsitologiya, 10: 1105-17(Sept. 1968). (In Russian).

Corn seedlings were irradiated with soft x rays at doses of 50 to 100 kR. The root length and the length of cells situated at different distances from the root tip were regularly measured. The growing zone of irradiated roots could be divided into two parts. The one region, analogous to the meristem, consisted of small cells, which length never changed throughout this region. In the other part, analogous to the elongation zone of a non-irradiated root, the cell length markedly increased towards the basal part of this region. The mitoses were completely blocked after the irradiation. The number of meristematic cells decreased with time according to the exponential low. The time during which the cell number was half reduced was equal to the average duration of the mitotic cycle in non-irradiated roots. The irradiation did not affect the period after which the cells in different parts of the meristem began to elongate. The rate of passing into elongation decreased as a result of the suppression of divisions. A relative rate of elongation also decreased after irradiation. The rate changes of root growth were mainly conditioned, during the growth period, by the rate of transition to elongation of meristematic cells. (auth)

2982 POST-IRRADIATION KINETICS OF THE CHROMOSOMAL ABERRATION AND THE RADIOSENSITIVITY OF THE PLANT CELL REJOINING SYSTEM. Paribok, V. P.; Krupnova, G. F.; Volkova, Z. M. (Inst. of Cytology, Leningrad). Tsitologiya, 10: 1118-26(Sept. 1968). (In Russian).

By fractionated x irradiation of moist Vicia faba seeds, a study was made on the post-irradiation kinetics of chromosome damages, manifested as two-hit chromosome aberrations (dicentrics and ring chromosomes). The doses of radiation (400 and 800 R) were divided into two equal parts by different intervals of time (15, 30, 45, 60, 90, 120, 180, and 240 minutes). With the increase of the interval between two doses, a decrease in chromosomal aberrations was shown. The rate of this decrease was the same in experiments irrespective of the value of the first dose applied (either 200 or 400 R). These results do not allow the conclusion that a damage of cell rejoining system occurs. With prolongation of the interval between two doses (180, 240 minutes), the number of chromosomal aberrations increased. As a possible explanation of this phenomenon, phase alterations in the chromosome radiosensitivity induced by the first irradiation dose are suggested. Chromosome reparation appears to be a local-independent one; the number of chromosomal aberrations decreased not only if calculated per a cell in general, but also per a damaged cell as well. (auth)

2983 CHARACTERISTICS OF THE ROOTS IN SEEDLINGS GROWN IN LINEN ROLLS: INDEXES OF THE GROWTH OF PLANTS UNDER FIELD CONDITIONS. Tavcar, A.; Kendelic, V. (School of Agriculture, Zagreb). Arh. Poljopr. Nauke, 19: 151-9(1966).

A method for studying the characteristics of seedling roots grown in linen rolls as indicators of the growth and development of plants cultivated under field conditions is described. The method was used to establish the germination capacity of corn seeds and the growth and development of roots of seedlings sprouted from seeds of different age, or treated with various doses of γ irradiation. Results indicated the method can be used to forecast the growth pattern of plants under field conditions. (auth) (TSS)

2984 ON THE EFFECTS OF IONIZING RADIATION EMITTED FROM ^{60}Co UPON THE GERMINATION AND THE GROWTH OF TIMOTHY GRASS (PHLEUM PRATENSE L). REPORT 2. STUDIES ON [DOSE-EFFECTS], [DOSE-RATE EFFECTS], AND [SUMMATION EFFECTS]. Nakatani, Tokuzo (Nihon Univ., Japan). Nichidai Igaku Zasshi, 27: 797-810(July 1968). (In Japanese).

The effects of ^{60}Co τ irradiation on germination and growth of Timothy Grass were studied. Seeds irradiated with dose of 10^4 to 10^5 R were sowed and their germination and growth were observed. The results obtained were as follows: In general, the germination and the growth of irradiated samples were always inhibited. It was recognized that the larger the irradiation dose, the larger the inhibitory effects. Dose-rate effects were recognized; the larger the irradiation dose-rate, the larger the effects. So called summation effects were also found, when the seeds were fractionally irradiated. (NSA of Japan)

Radiation Effects on Microorganisms

Refer also to abstracts 2740, 2788, 2790, 2792, 2807, 2809, 2868, 2901, 2919, 2994, and 4496.

2985 EFFECTS OF IONIZING RADIATION ON SYNCHRONOUS CULTURES OF ESCHERICHIA COLI B/r. Clark, D. Joseph (Univ. of California, Berkeley). J. Bacteriol., 96: 1150-8(Oct. 1968).

The sensitivity of Escherichia coli B/r to x irradiation is correlated with the replication cycle of deoxyribonucleic acid (DNA). The sensitivity to x irradiation in the wild type can be attributed to the presence of nuclear targets plus DNA repair mechanisms. The effects of nuclear targets are observed in the recombination-deficient (rec-) mutant B/r, but the sensitivity reflected by changes in the slope of killing curves is absent. A study of different growth conditions indicates that maximal resistance to x rays occurs toward the middle of the division cycle. Evidence is offered that branched chromosomes respond as one-hit targets to x irradiation. The killing effects of heavy-ion bombardment on E. coli are due primarily to ionizing radiation. (auth)

2986 RELATIONSHIP BETWEEN K-REACTIVATION AND UV-REACTIVATION OF BACTERIOPHAGE λ. Kneser, Hubert (Univ., Cologne). Virology, 36: 303-5(Oct. 1968).

Experiments on bacteriophages showed that mechanisms of uv reactivation were different for λ and T3 phages. Ultraviolet reactivation of T3 was blocked in one type of uv-sensitive mutant of Escherichia coli (Hcr$^-$ or Uvr$^-$), which, however, allowed uv reactivation of phage λ. It was shown that in a second type of uv sensitive mutant (Rec$^-$) uv reactivation of λ was blocked, and that the two types of mutation affected different reactivation mechanisms. Rec$^-$ mutants are characterized by their deficiency in genetic recombination, Hcr$^-$ by the lack of host cell reactivation. Relationships between the host cell reactivation and K reactivation are discussed. (H.L.W.)

2987 INFLUENCE OF HALOGENATED DEOXYURIDINES ON THE RADIATION SENSITIVITY OF ESCHERICHIA COLI. Moroson, H.; Tenney, D. (Sloan-Kettering Inst., Rye, N. Y.). Experientia, 24: 1039-40(Oct. 15, 1968).

Halogenated deoxyuridines, BUDR, FUDR, and IUDR, were investigated as bacterial sensitizers for x radiation. It was shown that IUDR only could function as a sensitizer, apparently as well by the formation of long-lived toxic molecules of iodine as by short-lived toxic iodine atoms. By increasing the dose of radiation, long-lived toxic radiation products were detected under aerobic conditions but not under anaerobic conditions. (H.L.W.)

2988 PHAGE INDUCTION BY ULTRAVIOLET RADIATION IN STRAINS OF ESCHERICHIA COLI POSSESSING AND LACKING DARK REPAIR CAPACITY. Takebe, Hiraku (Southwest Center for Advanced Studies, Dallas); Ichikawa, Haruko; Iwo, Kazuhiro; Kondo, Sohei. Virology, 33: 638-49(Dec. 1967).

Prophage induction by uv light in strains of E. coli possessing and lacking dark repair capacity was investigated. E. coli B and its uv-sensitive mutant B_{s-1} were lysogenized by temperate phage ϕ80. Relative prophage induction by uv in the 2 strains paralleled relative uv killing, suggesting that prophage induction in a uv-resistant strain is susceptible to dark repair. Photoreactivation of induction was observed in B_{s-1}(80), suggesting that the initial damage for uv induction of prophage in this very sensitive strain is due to formation of pyrimidine dimers. No recovery of induction, however, was observed in B(80) when the uv-irradiated cells were held in phosphate buffer at 37° although there was recovery of cell survival (liquid holding recovery). The frequency of spontaneous induction was much greater in B_{s-1}(80) than in other strains and one of the highest yet observed in bacteria. Although increased sensitivity to uv killing in the logarithmic phase is usually seen in lysogenic strains, B_{s-1}(80) was not more sensitive to uv killing than logarithmic phase B_{s-1}. Cell division after uv irradiation and before lysis, permitting viable cells among the progeny, could account for the lack of extra sensitivity in B_{s-1}(80). This phenomenon actually was observed microscopically, although the mechanism is not understood. (BBB)

2989 EFFECT OF TRANSFORMING DNA ON IRRADIATED COMPETENT CELLS OF BACILLUS SUBTILIS. Pogodina, O. N. (Inst. of Cytology, Leningrad). Tsitologiya, 10: 1203-7(Sept. 1968). (In Russian).

The influence of the transforming DNA on the process of recovery of the competent cells of x-irradiated Bacillus subtilis was studied. Two prototrophic strains of Bacillus subtilis, one of which was resistant to streptomycin, were used as donors of DNA. In all the experiments, the auxtrophic mutant ind$-$(168) served as a recipient. X ray doses used resulted in the survival of approximately 30% of cells treated. A postirradiated treatment of the competent bacteria with DNA was not found to influence the process of reparation of cell division. Similar data were obtained with the preparations of isologous DNA of different origin. Additional incubation of irradiated cells with DNA in the complete media had no influence on the process of the recovery as well. (auth)

2990 STUDIES REGARDING THE CHANGES IN GROWTH AND MULTIPLICATION OF SOME BACTERIA GROWN IN IRRADIATED CULTURE MEDIA. Chelemen, N.; Savulescu, M.; Ciocirlie, I.; Ignat, F.; Carp, N.; Bojoi, P.; Chiotan, C. Rev. Sanit. Mil., 63: 871-8(Nov.-Dec. 1967). (In Rumanian).

Nephelometric densities of Staphylococcus aureus Oxford grown for 3, 18, or 24 hours in irradiated broth; of "Welchia agni 85"; of toxin production by Clostridium perfringens, and physical chemical data of broth irradiated at 1000 and 1 million R are discussed. (JPRS)

2991 REPAIR OF ULTRAVIOLET LIGHT DAMAGED HEMOPHILUS INFLUENZAE AND ITS TRANSFORMING DNA. Day III, Rufus Spalding. University Park, Pa., Pennsylvania State Univ., 1967. 97p.

Thesis.

The recovery of Hemophilus influenzae and its transforming DNA from damage introduced by uv light was studied by the use of the basic dye acriflavine, which is known to inhibit the excision of certain uv photoproducts from E. coli DNA. It was found that the D_{37} of irradiated cells was reduced from 60 to 2 ergs/mm^2

when they were plated in agar containing 0.3 micrograms acriflavine per ml. When samples were taken as a function of time from the post irradiation incubation cultures and plated in agar with and without acriflavine, the cells were observed to become increasingly insensitive to the acriflavine produced sensitization (repaired), and after sufficient incubation time became totally insensitive to the sensitization. An equation, derived on the basis of reasonable but unproved assumptions, was used to find the rate constant of repair at various temperatures. The ΔH^* calculated from variation of the rate constant with temperature was found to be approximately 16 kcal/mole. When uv irradiated Hemophilus influenzae DNA bearing the streptomycin (Str) or the novobiocin (Nb) marker was used to transform competent cells in the presence and absence of acriflavine, the dye was observed to make the survival curve more sensitive. The relatively uv-resistant Nb marker was sensitized to a greater extent than the more sensitive Str marker. It was suggested that the reason for the higher uv-resistance of the Nb marker without acriflavine is due to a greater susceptibility to repair, and that acriflavine blocks this repair. Cells that contained both the Str and Nb markers were irradiated and subsequently incubated. As a function of time of incubation, DNA was extracted from the culture and used to transform competent cells in the presence and absence of acriflavine. It was found that the Str and the Nb markers were repaired to approximately the same extent under these conditions. (Disser. Abstr.)

2992 INTRINSIC INTERFERENCE: A NEW TYPE OF VIRAL INTERFERENCE. Marcus, Philip I. (Salk Inst. for Biological Studies, La Jolla, Calif.); Carver, David H. pp 77-98 of Medical and Applied Virology: Proceedings of the Second International Symposium. Sanders, Murray; Lennette, Edwin H. (eds.). St. Louis, Warren H. Green, Inc., 1968.

The hemadsorption-negative (HAD^-) plaque test made it possible to assay accurately rubella virus as a nonhemadsorbing, noncytopathic virus. The test was based on the fact that cells infected with rubella virus were completely refractory to superinfection by Newcastle disease virus (NDV), while remaining susceptible to many other viruses. This state of refractoriness was termed intrinsic interference. It was shown that the capacity to induce intrinsic interference was not restricted to rubella virus but could involve several kinds of seemingly unrelated noncytopathic viruses and also possibly some virulent types. Ultraviolet light inactivation of Sindbis and rubella viruses was studied under conditions where T2 phage and NDV could be used as biological actinometers. Rubella virus survivors were assayed as HAD^--PEP (plaque-forming particles) and Sindbis virions as PFP on young chick embryo cell monolayers. All survival curves showed one-hit inactivation kinetics. The 37% survival dose, D_0, defined as the dose of uv light required to reduce the number of infectious particles to e^{-1} (0.37 survivors = one lethal hit) was the same for both viruses, 110 erg/mm^2. For comparison, D_0 values for NDV and T2 phage irradiated in the same medium were 42.5 and 25 erg/mm^2, respectively. The uv-inactivated virus, usually at 5×10^{-5} survival level, was used immediately after irradiation. It was found that the capacity to induce intrinsic interference was lost from Sindbis virus following inactivation of plaque forming capacity with uv light. The same preparations of uv-inactivated Sindbis virus were still capable of inducing high levels of interferon production. (BBB)

2993 INTEGRATION AND INDUCTION OF PHAGE P22 IN A RECOMBINATION-DEFICIENT MUTANT OF SALMONELLA TYPHIMURIUM. Wing, Jennifer P. (Univ. of Michigan, Ann Arbor). J. Virol., 2: 702-9 (July 1968).

A recombination-deficient, uv-sensitive mutant of S. typhimurium strain LT-2 was described that was unable to undergo general transduction by phage P22, a process that involved recombination between the bacterial chromosome and a bacterial DNA fragment. On the other hand, recombination between appropriately marked phage P22 mutants infecting the Rec^- bacteria occurred with normal frequencies. Therefore, recombinational events involving only bacterial DNA were prevented by the Rec^- lesion, whereas, in those involving only phage DNA, the phage genome contributed a recombinational system that overcame the Rec^- lesion. It was shown that prophage integration did take place in a Rec^- strain, but induction of prophage by uv irradiation did not occur. Various explanations for this finding were investigated by using lysogens of a heat-inducible phage P22 mutant. At 37°C, the integration efficiency was only 10% of that in Rec^+ infection, but at 25°C the efficiencies in Rec^- and Rec^+ hosts were similar. Rec^- lysogens could not be induced by uv irradiation or by streptonigrin or mitomycin C. Heat induction of Rec^- cells lysogenic for a temperature-sensitive c_2 mutant (ts c_2) was normal, showing that the Rec^-(ts c_2) lysogens prior to heat induction did not prevent the formation of infective centers after temperature shift. Thus, the noninducibility of Rec^- lysogens was not due to destruction of the prophage as a result of uv irradiation. DNA-RNA hybridization experiments demonstrated that no increase in phage-specific RNA synthesis occurred after uv irradiation of a $Rec^-(c^+)$ lysogen. The Rec^- mutant appeared to lack part of the mechanism required to destroy the phage repressor and allow the initiation of early phage functions such as messenger RNA synthesis. (BBB)

Radiosterilization and Radiopreservation

Refer also to abstracts 2491 and 2914.

2994 (TID-24171) EFFECT OF IRRADIATION ON THE MICROBIAL FLORA SURVIVING IRRADIATION PASTEURIZATION OF SEAFOODS. Annual Report, April 1, 1966–March 31, 1967. Sinnhuber, R. O.; Lee, J. S. (Oregon State Univ., Corvallis. Dept. of Food Science and Tech.). Apr. 15, 1967. Contract AT(45-1)-1950. 67p. Dep. CFSTI.

Progress is reported on studies on the effects of pasteurizing doses of γ radiation on the survival of bacteria on seafoods. Data are reported on the growth characteristics of 16 species of Achromobacter isolated from irradiated Dover sole, crabmeat, ocean perch, and oysters following storage at 34°F. Most species grew in the presence of 7.5% NaCl and all were able to grow at 0°C. The average optimum growth temperature was between 24° and 28°C. The LD_{50} of buffer-irradiated Achromobacter species ranged from 5.0 to 75.0 Krad when compared with the LD_{50} in seafoods of 18.0 to 21.0 Krad. The spoilage of ocean perch was measured by total volatile acid (TVA) and total volatile bases (TVB) following inoculation of aseptically incised fish muscle with species of Pseudomonas and Achromobacter. Achromobacter, which was a major survivor in irradiated ocean perch, (Sebastodes abutus) grew well in fish substrate. A minimum level of bacterial growth was required before an increase in TVB was detected. More efficient TVB production was noted when fish muscle was inoculated in mixed natural flora than in pure Pseudomonas culture. Fish inoculated with Achromobacter produced the least amount of TVB. Results are reported from a study of microbial populations in chlortetracycline (CTC)-treated (50, 100, 200, and 500 ppM), frozen (−15°C), and γ irradiated (0.1 Mrad) ocean perch. Spoilage of control samples at 43°F was due primarily to the growth of Pseudomonas. Irradiation changed this to Achromobacter-dominated spoilage. The CTC sensitivity varied among isolates obtained from untreated fish. The proportion of CTC-resistant species increased with higher CTC concentration and length of storage at 43°F. Pseudomonas, Achromobacter, Flavobacterium, Bacillus, Lactobacillus, and yeasts all contained species either resistant or sensitive to CTC. More CTC-resistant species in these genera accumulated with increased CTC concentrations and with the length of storage in the presence of CTC. Frozen ocean perch lost approximately 17% of the original microbial count during a month of storage. Bacillus, Lactobacillus, and Micrococcus species were most susceptible to freezing, and gram-positive species showed different sensitivities to freeze damage. Microbial inactivation resulting from 0.1 Mrad γ radiation was in the order of 10^{-2}. The post-irradiation microbial flora was dominated by Achromobacter species at the expense of the Pseudomonas group. Data are tabulated on the effects of CTC treatment, freezing, and γ irradiation on the distribution of a number of microorganisms in fresh or stored ocean perch. (C.H.)

2995 EFFECT OF GAMMA RADIATION ON EXTENDING THE STORAGE LIFE OF ORANGES. Barkai-Golan, Rivka; Kahan, R. S. (National and University Inst. of Agriculture, Rehovot, Israel). Plant Dis. Rep., 50: 874-7 (Nov. 1966).

Experiments with Shamouti oranges inoculated with spore suspensions of Penicillium digitatum and P. italicum showed that γ radiation affects the incubation period of the fungi and thus extends the storage life of the fruit. Radiation with doses up to 100 krads showed no, or little, delay in the appearance of rot, while 150 or 200 krads prolonged the incubation period of the fungi to 10 to 35 days as compared with three days for the control. Radiation doses of 250 krads prevented entirely the appearance of rot during 80 days of storage at 23°C. Radiation was more effective on fruit inoculated with low initial spore concentrations. Its effect decreased with the increase in spore concentration. Peel damage and stem-end rots appeared on many of the irradiated fruits. (auth)

2996 IRRADIATION OF DUNCAN GRAPEFRUIT, PINEAPPLE, AND VALENCIA ORANGES AND TEMPLES. Dennison, R. A.; Grierson, W.; Ahmed, E. M. (Univ. of Florida, Gainesville). Proc. Fla. State Hort. Soc., 79: 285-92 (1966).

One grapefruit and three orange varieties were exposed to 100, 200, or 300 Krad of ^{60}Co γ radiation at 5.4 Krad/min. Irradiation with doses above 100 Krad induced some decay reduction in Pineapple and Valencia oranges stored at 70°F for 21 days without diphenyl pads. At 40°F there was less spoilage for the Temple fruit; with diphenyl pads and storage at 40°F there was less spoilage of Pineapple oranges. The citrus fruits examined showed radioinduced peel injury. Temple fruit were the least susceptible to peel injury. The severity of peel injury was greater as the radiation doses increased or the storage temperature and duration increased. There were no differences in the organoleptic quality attributes of irradiated grapefruit stored 19 and 20 days at 65 and 58°F, respectively. No differences were observed in the color or consistency of juice expressed from irradiated Valencia oranges, but a lower flavor rating was obtained from the 300-Krad level. Sections from Temple fruit irradiated with doses in excess of 100 Krad and stored seven days at 35 and 50°F were softer and had less acceptable flavor. However, by extending the storage period to 13 days, no differences were observed in the flavor of Temples stored at 50°F. In view of the severity of peel injury, irradiation could not be recommended for preservation of Florida citrus fruits. (BBB)

2997 REVIEW OF THE LITERATURE ON CRYOPRESERVATION OF BONE. Boyne, Philip J. (National Naval Medical Center, Bethesda, Md.). Cryobiology, 4: 341-57(May-June 1968).

Preservation of bone by cryotechniques, including use of ionizing radiation for sterilization, is surveyed. Radiation was successfully used in the sterilization of both frozen and freeze-dried homografts. Some investigators prefer β-ray sterilization to x-ray exposure and other forms of radiation because of the inherent efficiency and the accuracy of control of the β-ray dose. Disadvantages of β radiation are related to relatively low penetration compared with that of x rays and ^{60}Co γ rays. Maximum penetration of cortical bone is ~1.5 cm. at a dose of 1 Mrep given at dry ice temperatures (−78°C) there is no detectable impairment of healing of freeze-dried homogenous bone grafts in dogs. At higher doses, 2 to 6 Mrep, however, significant impairment of freeze-dried bone graft acceptance occurs. Paradoxically, the same doses appear to accelerate the acceptance of frozen bone homografts. This advantage, however, may be outweighed by the superior rate of histological acceptance of the freeze-dried bone. Morphological changes in the irradiated bone include a grossly evident decrease in elasticity, making for brittle cancellous grafts. An increase in basophilic staining of irradiated grafts following implantation and some impairment of the cement line between the graft and the invading host bone can be noted histologically. It is concluded that radiation is a satisfactory method for sterilizing properly preserved bone homografts. (BBB) (TSS)

2998 GAMMA IRRADIATION INFLUENCE ON THE STORAGE AND NUTRITIONAL QUALITY OF MUSHROOMS. Campbell, J. D. (Univ. of Manitoba, Winnipeg); Stothers, S.; Vaisey, M.; Berck, B. J. Food Sci., 33: 540-2(May 1968).

Growth of freshly harvested mushrooms subjected to 100 krad of γ irradiation was markedly inhibited, as measured by the small number of broken veils. This could significantly increase the storage life of mushrooms even under suboptimal conditions. Untreated mushrooms were preferred to the treated, but hedonic scores indicated that the treated mushrooms would be acceptable. There was no significant change in rate of moisture loss, or in reducing sugar or dry matter content of the irradiated mushrooms. Respiration of irradiated mushrooms is accelerated up to about three days after treatment and then slows markedly. The inclusion of 20% irradiated mushrooms in mouse diets fed in late pregnancy and lactation had no significant effects on the average mouse weight of the offspring 40 days old or on their daily food intake and weight gain in a subsequent six week feeding period. (auth)

2999 FOOD IRRADIATION: PHYSIOLOGY OF FRUITS AS RELATED TO FEASIBILITY OF THE TECHNOLOGY. Maxie, E. C.; Abdel-Kader, Adel (Univ. of California, Davis). Contract UCD-34P80. Advan. Food Res., 15: 105-45(1966).

The effects on fruits of ionizing radiation, used in attempts to extend their shelf-life, are reviewed, with 124 references. The following topics were considered: fruit respiration in relation to radiation effects for both climacteric and nonclimacteric fruits, effect of irradiation on texture of fruits, effect of radiation on chemical components of fruits (nutritionally significant compounds and other chemical constituents), effects of radiation on organoleptic attributes of fresh fruits, wholesomeness of irradiated fruits, induced radioactivity, ozone produced by ionizing radiation and its relation to fruit behavior, and feasibility of irradiation as a commercial technology with fresh fruits. It was concluded that irradiation could be used to advantage in studying any biochemical or physiological event in fresh fruits. It was of particular value in studying ripening, for it delayed the senescence of tissues in some cases while hastening it in others. Studies of irradiation effects on the interrelation of rate of respiration and the production of ethylene and other volatiles were helpful in understanding these processes. Much research was needed on radiological degradation and/or induced synthesis of the compounds associated with aroma and flavor. In the area of irradiation effects on the texture of tissues, much more work was needed, particularly on methods of modifying the injury. Such studies could reveal the means for a feasible irradiation technology with fresh fruits and contribute to knowledge of cell structure as it might affect responses to stress conditions. (BBB)

3000 STUDIES ON THE X-RAY STERILIZATION OF FREEZE-DRIED AORTIC SEGMENTS. Flemming, Hans; Hirsch, Hans H.; Unnewehr, Friedrich (Chirurgische Univ., Frankfurt am Main). Arch. Klin. Chir., 315: 323-8(1966). (In German).

Nonsterile thoracic aorta segments from freshly slaughtered sheep were freeze-dried, wrapped in polyvinyl chloride foil, sterilized by exposure to a dose of 2.5×10^6 R of x irradiation, and tested for sterility. All of the samples irradiated with this dose were completely sterile, but from 10 to 50% of aortic samples irradiated with a 4.3×10^5, 0.5×10^6, 1×10^6, or 2×10^6 R dose were nonsterile. The lethal doses for various types of microorganisms were listed. These doses range from 0.1 to 2.5×10^6 R for bacteria, and from 0.08 to 0.52×10^6 R for viruses. Methods for preparation and freeze-drying of the samples were given in detail. (BBB)

3001 RADIATION STERILIZATION OF MEDICAL DEVICES AND SUPPLIES. 4. THE EFFECT OF IRRADIATION ON THE TENSILE STRENGTH OF THE VARIOUS SURGICAL SUTURES. Sato, Kenji; Ito, Nobuo (Tokyo Metropolitan Isotope Research Center). Eisei Kagaku, 14: 225-7(Aug. 1968). (In Japanese).

The effects of irradiation on the tensile strength of surgical sutures, such as braid and twist silk, nylon monofilament, polyester (tetron, indexed as ethyl pyrophosphate) braid, and tetrafluoroethylene (teflon) braid, were investigated. The tensile strength of the sutures decreased with increasing irradiation dose, but the decreasing ratio of the strength of the sutures, except teflon braid, irradiated at 2.5 MRAD in dry state, was less than 10%. A significant decrease in tensile strength of the teflon braid sutures was observed following irradiation at less than 1 MRAD. Water solubility of irradiated silk sutures increased slightly with increasing irradiation dose. (NSA of Japan)

3002 GAMMA IRRADIATION AND ENRICHED CO_2 ATMOSPHERE STORAGE EFFECTS ON THE LIGHT-INDUCED GREENING OF POTATOES. Ziegler, R.; Schanderl, S. H.; Markakis, P. (Michigan State Univ., East Lansing). J. Food Sci., 33: 533-5 (May 1968).

Michigan-grown Kennebec and Sebago potato tubers were exposed to γ irradiation in the dose range of 0 to 400 Krad and subsequently stored in atmospheres containing 0.03% to 15% CO_2. Upon illumination with 3,000 lux for periods up to 20 days while maintaining the atmosphere, all tubers developed some greening. The tubers exposed to 200 and 400 Krad were inhibited from greening to the highest degree but suffered general quality loss. The levels of 10 to 20 Krad, that are suitable for the sprout inhibition of potatoes, did not cause significant inhibition of greening under any of the conditions of this experiment. Storage in enriched CO_2 atmospheres inhibited the greening to the extent of 50% at 15% CO_2, only upon prolonged illumination (12 days), while irradiation (40 Krad) was only effective after a short period (4 days) of illumination. Irradiation in the 0 to 40 Krad range did not increase the inhibition caused by CO_2. The inhibition of potato greening by irradiation was effective through a period of five weeks storage in the dark prior to illumination. (auth)

3003 EFFECTS OF GAMMA-IRRADIATION ON THE BIOCHEMICAL STORAGE AND BREADMAKING PROPERTIES OF WHEAT. Fifield, Colburn C. (Agricultural Research Center, Beltsville, Md.); Golumbic, Calvin; Pearson, Jack L. Cereal Sci. Today, 12: 253-7; 261-2(June 1967).

Gamma radiation in dosages of 10, 25, 50, 125, and 175 krads was applied to hard red winter wheat that was subsequently stored for one year at 75°F. Quality tests were made immediately after treatment and every three months thereafter on the stored samples. Germination was unaffected by radiation dosages of 10 and 25 krads. However, at 50 krads a substantial reduction in germination was noted. At the two highest levels of treatment of the wheat, viability was completely destroyed. Progressive and important decreases in sedimentation values, indicating chemical changes in gluten proteins, were associated with increasing radiation dosages. Sedimentation values for the treated samples remained unchanged during storage. Other criteria such as test weight, flour yield, pearling index, fat acidity, wheat and flour protein, flour ash, diastatic activity (maltose) content, glutamic

acid decarboxylase (enzymatic) activity, capacitance-resistance measurements, protein solubility in NaCl and alcohol solutions, and rheological properties of the doughs were unchanged by treatment at any of the radiation levels. Bread characteristics (loaf volume, crumb grain, and crumb color) were unchanged by increasing dosages of radiation. Bread from wheat treated at 125 and 175 krads had a definite scorched or burned odor when removed from the oven. After bread cooled to room temperature, however, systematic taste-panel studies detected no statistically significant differences in odor or flavor of bread made from irradiated wheat as compared with bread made from untreated wheat. Breadmaking quality, except for color, remained remarkably good during storage of the wheat. (auth)

3004 ATOMS AND ONIONS. **Davies, John. Ont. Hydro Res. News, 53: 10-11 (Feb. 1966).**

The shelf life of various foods is being greatly extended by irradiation. After irradiation, potatoes can be successfully stored at temperatures up to 70°F and still retain their marketability. Potatoes treated in this way retained their firmness from 15 to 18 months with taste and other desirable qualities unimpaired. Canadians have been eating irradiated potatoes since 1961. The world's first commercial food irradiation facility is now in operation at Mont St. Hilaire, Quebec. A $1,200,000 development, it irradiates and stores up to 15,000,000 lb of potatoes. The feasibility of using ^{60}Co γ irradiation to inhibit sprouting in some fruit and vegetables has been established. The first U.S.–Canadian research program on radiation preservation of food got under way in 1965 when scientists from the two countries began a 2-year study on extending the shelf life of chicken by low-dose radiation pasteurization. Radiation pasteurization is expected to double shelf life and result in more stable marketing operations and in wider marketing areas for breeders, processors, shippers, and sellers. Only a year ago the first commercial irradiation plant in Canada to sterilize surgical sutures began operation near Peterborough. The sutures, with needles attached, are exposed to a ^{60}Co source after packaging and arrive at the operating theatre guaranteed sterile. (BBB)

3005 CONCLUSIONS ABOUT RADIATION: U.S.D.A. TEAM DEALS WITH THE QUESTION "DOES GAMMA IRRADIATION OF FRESH FRUITS AND VEGETABLES EXTEND THEIR MARKET LIFE?" **Lipton, W. J.; Harvey, J. M.; Couey, H. M. (Western Fruit and Vegetable Investigation Lab., Fresno, Calif.). United Fresh Fruit Veg. Ass., Yearb., 1967: 173-4; 176; 178; 181.**

Fruits and vegetables were irradiated by a 40,000 ^{60}Co source in a dose range from 6.3 to 500 kR, depending upon the commodity treated. After irradiation, the fruits or vegetables were exposed to simulated or actual transit environments. Irradiation successfully retarded postharvest growth and aging in mushrooms and sprouting of sweet-potatoes. Mushrooms were relatively resistant to radiation injury, and the growth of sweet-potato sprouts was inhibited at very low, noninjurious doses. Irradiated vegetables frequently decayed more rapidly than those not treated, and in some cases, where decay was reduced, physiological injuries occurred that impaired market quality. In chill-sensitive vegetables, radiation increased decay substantially. Of the fruits, decay of strawberries and of certain varieties of fig and peach was reduced by irradiation without injury to the commodity. Undesirable softening, discoloration, and loss of flavor resulted from irradiation of many fruits. Radiation did not appear to be a promising treatment for retarding decay of most fresh fruits and vegetables or for extending their market life. This conclusion diverges from earlier optimistic appraisals of the benefits of irradiation, that were based largely on results with processed or partly processed foods, not on the reactions of living tissue to irradiation. (BBB)

3006 EFFECTS OF GAMMA-RAY IRRADIATION ON METABOLIC CHANGES IN POTATO TUBERS IN RESPONSE TO CUTTING. **Ogawa, Masami; Majima, Reiko (Nagoya Univ., Japan). Plant Cell Physiol. (Tokyo), 9: 511-18 (Sept. 1968).**

Potato tubers were subjected to ^{60}Co γ irradiation and stored at room temperature for from 10 days to four months. Effects of this irradiation on metabolic changes in potato tubers in response to cutting were investigated. The quantities of polyphenols, such as chlorogenic acid and isochlorogenic acid, in the tissue increased as compared with the non-irradiated sample. Although the polyphenol content and activities of o-diphenol oxidase, peroxidase and phenylalanine ammonialyase increased after cutting, increases were lower in the irradiated sample. On the other hand, in the dose range between 5,000 and 12,400 rad, the irradiated sample showed a larger defense action against infection by the black rot fungus, Ceratocystis fimbriata than did the non-irradiated sample. (NSA of Japan)

3007 SINGLE AND MULTIPLE DOSES IN THE RADIATION PASTEURIZATION OF SEAFOODS. **Liston, J.; Matches, Jack R. (Univ. of Washington, Seattle). Food Technol., 22: 81-4 (July 1968).**

Use of ^{60}Co γ radiation at a dose rate of 300 Krad/hr and doses from 50 to 300 Krad to pasteurize English sole (Parophrys vetulus) is reported. Packaged fish fillets, taken from fish freshly caught and iced for eight and 16 days, were irradiated and stored at 1.1°C. For fresh fish carrying 10^3 bacteria/g, a count of 10^6/g was reached in 18, 24, 28, and 35 days after single doses of 100, 150, 200, and 300 Krad respectively, but only after 32, 34, 31, and 36 days for multiple doses of 50 + 5, 50 + 100, and 100 + 200 Krad respectively. Experiments using fish iced eight and 16 days indicated that the effectiveness of both single and double dose treatments decreased as bacterial count increased. For fish iced eight days (10^4/g count) using 50 + 100 Krad, the second dose was effective if administered within three days of the first dose but not later. In fish iced 16 days ($10^{5.5}$/g count) single doses of 50, 100, and 150 Krad delayed outgrowth to 10^6 by two days, but double doses of 50 + 100 Krad were essentially ineffective. Fillets prepared from whole fish irradiated at 50 Krad and stored for seven days had a shelf-life one to two weeks longer than fillets from comparable nonirradiated fish. Multiple dose treatments thus appeared feasible and desirable for fish irradiated on board ship where the second dose could be given on landing. (BBB)

3008 IRRADIATION INACTIVATION OF BROWN ROT INFECTIONS ON PEACHES. **Kuhn, G. D.; Merkley, Margaret S.; Dennison, R. A. (Univ. of Florida, Gainesville). Food Technol., 22: 91-2 (July 1968).**

The relation of a 200-Krad irradiation dose from a ^{60}Co source and the interval between inoculation and irradiation on the incidence and development of brown rot infections on peaches was studied. Time interval between inoculation and irradiation affected the growth response of Monilinia fructicola honey infections (brown rot) and the irradiation dose needed for its control. When firm-ripe peaches were irradiated (200 Krad) within 24 hr after inoculation, only 10% of the inoculations formed lesions. Postponing irradiation to 36, 48, or 60 hr after inoculation increased the incidence of lesions to 60, 80, and 90%, respectively. Infections formed on fruit irradiated 36 to 48 hr after inoculation were atypically small and possibly arrested. Typical infections appeared on fruit irradiated 60 hr after inoculation, but their development was slower than on nonirradiated fruit. Thus, unless the interactions of peach ripeness and infection times of M. fructicola were within the parameters controlled with a 200-Krad dose, the results of irradiating peaches to inactivate brown rot infections would be speculative and possibly ineffective. (BBB)

3009 PACKAGING OF IRRADIATED FOODS. **Killoran, John J. (Army Natick Labs., Natick, Mass.). Mod. Packag., 40: 179-83 (Apr. 1967).**

Research has continued to establish the safety of flexible plastic film packages for irradiated foods. Flexible packages were found to be ideal for electron irradiation. At the present time, there is no generally accepted method that can be used to indicate whether a food package was irradiated and how much radiation was applied. The packaging material, itself, appears to offer an ideal indicator through such physical or chemical changes as thermoluminescence. The U. S. Atomic Energy Commission and the U. S. Department of Commerce have agreed to join in a cooperative program with industry to construct and operate a pilot-plant irradiation facility for processing meat and poultry products. The U. S. Department of Defense will support the facility for at least three years by procuring a minimum of 300,000 lbs. annually of the acceptable shelf-stable foods. The procurement will relate to products, both food and packaging, cleared by FDA and USDA and will be used by the military. Initially, the foods will be packaged in metal cans; subsequently, in flexible packages cleared by FDA. (auth)

3010 NEW PERSPECTIVES IN DEVELOPMENT OF PRESERVATION TECHNIQUES IN THE FOOD INDUSTRY. **Rach, Pavel (Distillation and Preservation Research Inst., Prague). Prum. Potravin, 17: 455-62 (1966). (In Czech).**

Some average per capita food consumption data are given for Czechslovakia and compared with those of other countries. Various techniques for preservation of food, including the use of ionizing radiation, are reviewed (130 references, some Czech) with consideration of both pasteurization and sterilization. The raw materials processed, storage methods, preliminary treatment, and technology of processing fruits and vegetables are discussed. Some economic data are presented together with vitamin-loss figures, comments on wholesomeness, organoleptic properties, etc. (TTT)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstract 3107.

3011 (NTO-SOP-90(Rev.1)) QUALITY AND WORKMANSHIP MANUAL FOR WELDING. Phillips, M. D. (Aerojet-General Corp., Jackass Flats, Nev.). Apr. 30, 1968. 75p. GPO $0.70.

A manual was compiled to define and describe the workmanship and quality practices which are acceptable for the fabrication by fusion welding of components, piping, assemblies, and systems for the NERVA program at NRDS. Included are written and pictorial descriptions of basic rules for welding, filler materials, electrodes, shielding gas, types of welds, materials to be welded, and safety requirements. (L.C.L.)

3012 (ORNL-4315) HEAVY-SECTION STEEL TECHNOLOGY PROGRAM. Semiannual Progress Report for Period Ending February 29, 1968. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 160p. Dep. CFSTI.

Progress on the Heavy-Section Steel Technology (HSST) Program for the investigation of the structural behavior of thick-section pressure vessels for water-cooled reactors is reported. Heat treatment of the second program plate, a 20 ft × 10 ft × 1 ft-thick A533, Grade B, steel plate, was completed and the desired temperatures obtained during quenching. Heat treatments of plates 03 and 04 are underway. Unirradiated specimens from the first program plate of 12 in.-thick A533, Grade B, steel have undergone inspection, mechanical properties tests, variability determinations, transition temperature investigations, fracture mechanics studies, and fatique-crack propagation tests. The procedures and results are described. The fracture toughness of A302, Grade B, steel, both unirradiated and irradiated specimens, was investigated. An irradiation program is being formulated to meet the needs of the HSST Program for studying irradiation effects. The results of pre-irradiation testing of materials for this are given. Plans are described for the necessary pressure vessel investigations which will apply the laboratory test findings to the behavior of operating power reactor pressure vessels. These include complex stress-state studies, procedures for periodic proof-testing and warm-prestressing, and simulated service tests. Factors affecting the cost of various large simulated service test vessels have been analyzed and tabulated. (L.C.L.)

3013 DIFFUSIONAL GROWTH OF STATIONARY GAS BUBBLES IN SOLIDS. Markworth, Alan J. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 504(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3014 METALS AND CERAMICS. Olds, G. C. E. Edinburgh, Oliver and Boyd, 1968. 142p. 7s. 6d.

The subject is discussed under the following headings: the background; how do atoms of metals and ceramics differ?; metal crystals and ceramic crystals; microstructure—the basis of properties; limitations of metals and ceramics; strategy and tactics of materials research; metals in gas turbines and steam turbines; materials in nuclear reactors; ceramics in electronic and power equipment; high temperature and space technology; metals and ceramics tomorrow. (UK)

3015 Zr, Hf, Ti NEWSLETTER, JULY 1968. Akron, N. Y., Amax Specialty Metals, Inc., 1968. 12p.

The metallurgy, properties, and projected uses of Hf, Ti, Zr, their alloys and compounds are reviewed in accord with current research. One hundred-thirteen references. (P.G.C.)

3016 DUCTILITY. Papers Presented at a Seminar of the American Society for Metals, October 14-15, 1967. Metals Park, Ohio, American Society for Metals, 1968. 390p. (CONF-671051).

A total of twelve papers were presented at the conference. Separate abstracts were prepared for each of three of the papers. One paper was previously abstracted in NSA as 22: 13037. Papers for which no abstracts were prepared are concerned with ductility, materials variables, dislocation, hot working, cold working, anisotropic sheet metal, fracture, and structural design. (P.G.C.)

For abstracts of individual papers see: 3061–3063.

3017 TEKHNOLOGIYA TUGOPLAVKIKH METALLOV I SPETSIAL'NYKH SPLAVOV. (Technology of High-Melting Metals and Special Alloys). Mal'tsev, M. B. Trudy Instituta. Vypusk XXVIII. Moscow, Izdatel'stvo Metallurgiya, 1968. 107p.

Fourteen articles are presented on the technology of high-melting metals. Recrystallization of modified Mo and its alloys, thermal treatment of V, Nb and Ta, properties of Nb–Mo alloys, and structures of hot-pressed and hydroextruded tungsten are discussed. Information is included on non-cooled sorption traps for electron-beam and other metallurgical vacuum installations, uses of industrial hydrostatic extrusion with high-pressure liquid, effects of the media on Zr structure, and means for improving the quality of high-melting metals and their alloys. Effects of carbon on mechanical properties and structure of Mo prepared by electron-beam melting and the welded Mo compounds are also discussed. (R.V.J.)

Corrosion and Erosion

Refer also to abstracts 4310 and 4456.

3018 (N-68-25722) SLURRY APPLIED DUPLEX COATINGS FOR TANTALUM AND COLUMBIUM ALLOYS. Stetson, A. R.; Wimber, R. T. (Solar, San Diego, Calif.). 1967. Contract NAS3-7276. 38p. (CONF-670730-1; NASA-CR-87765; RDR-1471). CFSTI.

From 13th Meeting of the Composites Working Group, Seattle, Wash.

A duplex silicide coating process is described in which a modifier alloy is slurry applied and vacuum sintered onto the substrate preparatory to pack siliciding. Data are presented on the ability of the coatings to protect tantalum and niobium alloys from oxidation in the temperature range of 1600 to 3600°F. The data indicate protective lives of the coatings on the T-222 tantalum alloy in excess of 600 hours at 1600 and 2400°F, in excess of 20 hours at 3100°F, up to 8.5 hours at 3500°F and up to 1.75 hours at 3600°F. Niobium alloys are afforded in excess of 570 hours of protection at 1600°F and in excess of 220 hours at 2400°F under a variety of test conditions. After both ballistic and falling ball impacting at R. T. and 2200°F, the coatings are protective for 1 to more than 16 hours in the temperature range of 1600 to 2400°F. Basically, the compositions are W and/or Mo silicide modified with titanium and/or vanadium. The three most promising compositions are $(35\ Mo-35\ W-15\ Ti-15\ V)Si_2$, $(95\ W-5\ Ti)Si_2$, and $(95\ Mo-5\ Ti)Si_2$. (STAR)

3019 (NAA-SR-Memo-12232) SCTI: PRESSURE REDUCING VALVE BODY FAILURE. Wagner, R. K. (Atomics International, Canoga Park, Calif.). Nov. 2, 1966. 27p. Dep. CFSTI.

Metallographic examination of a failed Type 347 stainless steel cast reducing valve body revealed two weld repairs, one in the critical area opposite the outlet connection in the lower body/seat web junction adjacent to the major crack, and a martensitic microstructure in the weld metal as opposed to the duplex-austenite/ferrite microstructure typical of the valve body material. A microprobe analysis, from the base material into the weld metal, indicated a wide variation in composition. It was concluded that sub-standard quality was a major factor contributing to failure of the valve body casting and that the major fracture was a direct result and a continuation of cracks and other discontinuities originating on the internal surfaces of the valve body. (auth)

3020 (WAPD-TM-786) EFFECT OF TEMPERATURE AND TIME ON ZIRCALOY OXIDE FORMATION AND ITS REMOVAL BY PICKLING. Taylor, C. V.; Goodwin, J. G. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sept. 1968. Contract AT-11-1-GEN-14. 9p. Dep. CFSTI.

Results of studies performed to determine the limiting oxide film thickness on Zircaloy which can be removed by pickling are presented. Useful guidelines are given for those engaged in the fabrication of finished Zircaloy components where heating for forming is desirable, but where removal of oxide by mechanical means is difficult or impossible. Also included is information concerning the thickness of oxide formed as a function of time at normal Zircaloy forging, hot rolling, and annealing temperatures and the concomitant depth of oxygen penetration (solid solution) in the metal. The latter data are useful in determining the amount of metal to remove by pickling after the visible oxide is removed from Zircaloy heated to the normal fabrication temperatures. The effect of any working of the metal on the thickness of the oxygen-rich layer must be considered, because the data represent a "worst case" in that they were obtained from plates heated at 1550°F or 1860°F but not reduced in thickness by working. (auth)

3021 CONTRIBUTION TO THE STUDY OF HOT CORROSION. Seybolt, A. U. (General Electric Co., Schenectady, N. Y.). Trans. Met. Soc. AIME, 242: 1955-61(Sept. 1968).

Experiments on both sulfidation and hot corrosion have been carried out using ternary Ni–Cr–X alloys and commercial nickel-base superalloys. It has been shown that there are certain microstructural similarities between sulfidation using H_2S/H_2 mixtures and hot corrosion using Na_2SO_4 in "crucible" experiments or hot corrosion tests using a flame tunnel apparatus. It is proposed that two key processes in the hot corrosion process are formation of chromium sulfides which deplete the alloy matrix and oxidation which can be accelerated because of chromium depletion. Other processes play an important role in the hot corrosion process, such as accelerated oxidation attack due to the presence of a Na_2SO_4 or Na_2SO_4-NaCl film which inhibits the formation of a protective external oxide scale. (auth)

3022 STEAM-COOLED FUEL ELEMENT FOR NUCLEAR REACTORS. (to Licentia Patent-Verwaltungs-GmbH). British Patent 1,132,874. Nov. 6, 1968. Priority date Feb. 17, 1965, Germany.

A steam-cooled fuel element with ceramic fuel and metal casing is described. The casing on the boiling water side of the ceramic (UO_2) tubular fuel element is of Zr or Zr alloy. On the steam cooling side, the fuel is separated from the steam by a Zr or Zr alloy which is coated with Cr–Fe alloy of high Ni content to protect the Zr from corrosion. (F.S.)

3023 A FIELD-EMISSION MICROSCOPE INVESTIGATION OF THE EFFECTS OF AMBIENT ATMOSPHERES ON THE STRESS–CORROSION CRACKING OF URANIUM–MOLYBDENUM ALLOYS. Sulsona, Herman. Tucson, Ariz., Univ. of Arizona, 1968. 128p.

Thesis.

The effects of heat treatment and ambient atmospheres on the stress-corrosion cracking behavior of U-10 wt % Mo were investigated using a field-emission microscope of cylindrical geometry. Cathodic protection and the effect of static electric dc fields were investigated as possible protective techniques in the stress-corrosion cracking of U-10 wt % Mo. A special gas shield protective technique was also investigated. The stress-corrosion cracking behavior of U-10 wt % was found to be influenced by heat treatments. A gamma homogenization and quench followed by a tempering treatment were found to be most beneficial in reducing the susceptibility of the alloy. A tentative critical stress for initiation of stress-corrosion cracking was set at 36,500 psi. This critical stress was found to be strongly dependent upon heat treatments and internal structure. Cracking of U-10 wt % Mo in specific atmospheres was found to be either intergranular, transgranular or both, depending on the particular atmosphere. Intergranular cracking was found to be caused by pure, dry oxygen, while transgranular cracking was found to be promoted by increasing the water vapor content of the atmosphere. U-10 wt % Mo was found to be susceptible to hydrogen embrittlement. Cathodic protection and electric fields had no effect on the stress-corrosion cracking behavior of U-10 wt % Mo. Pure, dry nitrogen, on the other hand, was found to be most effective as a protective shield during cyclic loading of U-10 wt % Mo specimens. (Disser. Abstr.)

3024 MECHANICAL DAMAGE IN A LIQUID-METAL VORTEX. Cochran, J. T.; Collins, G. D. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 651-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3025 BURNING AND EXTINGUISHING CHARACTERISTICS OF PLUTONIUM METAL FIRES. Felt, R. E. (Atlantic Richfield Hanford Co., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 526(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3026 INVESTIGATION OF SODIUM PENETRATION INTO 304 STAINLESS STEEL WITH THE LASER MICROSPECTROPHOTOMETER. Sowa, Edmund S. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 505-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3027 OXIDE GROWTH AND SPALLING OF Fe–Cr ALLOYS STUDIED BY HOT STAGE MICROSCOPY. Howes, V. R. (Central Electricity Research Labs., Leatherhead, Eng.). Corros. Sci., 8: 729-36(Oct. 1968).

Direct observations by hot stage microscopy of the oxidation of a range of Fe–Cr alloys showed variations in oxide development. All the oxides formed were Cr_2O_3, with small amounts of Fe present. Changes in the surface micro-roughness of the oxide were related to void formation at the metal–oxide interface, and to the negative deviation from parabolic kinetics that was detected by weight gain measurements during oxidation. The gradual development of extensive oxide ridges over the alloy gain boundaries illustrated the important influence of these boundaries upon the oxidation of the alloys. The oxide spalling that occurs upon cooling after oxidation was also directly observed for the same range of Fe–Cr alloys. The spalling was initiated and was always more predominant at the oxide ridges formed at the alloy grain boundaries. The formation of the oxide ridges and the spalling upon cooling increase as the Cr content of the alloys increases, and explanations for this are discussed. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 2227, 2466, 2488, 2492, 2528, and 3085.

3028 (CEA-R-3390) THERMODYNAMIC APPROACH OF THE PILOT-SCALE PURIFICATION OF REFRACTORY METALS. Accary, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1968. 38p. (In French). Dep.

It is shown how thermodynamics can be applied to the prediction of the evolution of impurities from a metal or an alloy being melted and cast on a pilot scale using electron bombardment and continuous casting in water-cooled copper. This possibility is studied using vanadium and uranium monocarbide. Using only the constants available in the literature and a few special runs in the pilot equipment, it is possible to determine: (1) The possibility of elimination of any one impurity by keeping the material in the melted state under vacuum as well as the limit of purification which is achievable under given technological conditions. (2) The proportion of an impure metal which should be vaporized in order to bring the level of a given impurity down to a predetermined level and the necessary duration of heating. (D.L.C.)

3029 (EUR-4041) FORMATION OF ALLOYS BETWEEN LOW AND HIGH MELTING METALS BY THE REDUCTION OF VOLATILE METAL HALIDES AND CLARIFICATION OF THE COMPOSITION OF THE ALLOYS OBTAINED BY THIS PROCESS. Heumann, Th.; Venker, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 3, 1968. 76p. (In German). Dep.

A process is described for the preparation of alloys of metals with a widely different melting-point. Volatile halogenides of the high-melting-point component are passed through the liquid low-melting-point metal, where they are reduced. The liberated metal atoms react with the melt and equilibrium conditions are obtained because kinetic obstructions (such as a too small diffusion coefficient) are eliminated. Mo–Zn and Nb–Zn-alloys are prepared by this method and the corresponding phase-diagrams are determined by microscopic, thermoanalytic and x-ray examinations. (auth)

3030 (EURAEC-2050) STAINLESS STEEL CLADDING OF HEAVY GAGE STEELS. Quarterly Report No. 15, January 1–May 31, 1968. (Soudometal, S. A., Brussels (Belgium)). Translated from a French report. 26p. (EUR-3993). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The 15th and final report on a research program to develop techniques for cladding heavy gage steels with stainless steel recapitulates experimental conditions, gives data on welding currents, composition of SS tapes used, fluxes, and slags, and summarizes the factors which influence the chemical composition of claddings produced by this method. (P.G.C.)

3031 (UCRL-50487) USE OF NITRIDES FOR DISPERSION-STRENGTHENING OF REFRACTORY METALS. Kane, J. S. (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 6, 1968. Contract W-7405-eng-48. 12p. Dep. CFSTI.

A discussion of the dispersion-strengthening method for giving high-temperature creep resistance to refractory metals and alloys includes methods for securing the dispersions, choice of metal matrices, intermetallic compounds, precipitation of stable nitrides into solid solutions, production of two-phase co-vapor deposited materials, and potential uses in space power reactor structures. (P.G.C.)

3032 (Y-1654) HIGH-DENSITY TUNGSTEN SPHERES. Nash, J. H.; Neeley, A. C.; Steger, P. J. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Nov. 18, 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

Two, four-inch-diameter, unalloyed tungsten spheres were machined and lapped to a sphericity of better than five microinches and a background surface finish of less than three microinches, peak to valley. The material used was a special, uni-

form-density, gas-pressure-bonded tungsten made specially for the job. (auth)

3033 ELECTROPLATING PROCESS. Chauvin, Guy; Facquet, Louis; de Fouchier, Alain; du Deschaux, Louis de Vaulchier (to Commissariat a l'Energie Atomique). British Patent 1,132,808. Nov. 6, 1968. Priority date Mar. 17, 1966, France.

A method of electrodeposition of metallic coatings on electrically conductive parts fabricated of uranium and uranium base alloys is described. The method consists of electrodepositing a first coating of at least one metal, degassing the metal coating, mechanically treating for closing surface defects in the coating, and electrodepositing a second coating consisting of at least one metal layer to provide an impervious composite coating. At least one of the coatings must be formed by successive deposition of layers of different metals. (F.S.)

3034 INVESTIGATIONS ON ALLOYS OF VIa METALS. Fieffer, R.; Bach, H.; Tauscher, W. (Technische Hochschule, Vienna). Planseeber. Pulvermet., 16: 169-77(Oct. 1968). (In German).

Investigations are reported on replacing tungsten partially or completely by chromium or molybdenum in the so-called "heavy metals." Using Cr, Mo, Mo/Cr, and Cr/W and Ni-Cu-binders it was possible to obtain infiltrated or sintered materials with heavy-metal structure. The specimens were tested for hardness, bending strength, corrosion and scaling behavior and other technical properties. It was shown that under certain conditions the tungsten in the tungsten heavy metal alloys can be partly or wholly replaced by chromium and molybdenum, frequently with improvements in the properties. (auth)

3035 FABRICATION OF ^{152}Eu METAL TARGET FOR CROSS-SECTION MEASUREMENTS. Poggenburg, J. K.; Kobisk, E. H.; Butler, T. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 453-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3036 ELECTRON BEAM WELDING OF BERYLLIUM. PART TWO. Hauser, D.; Monroe, R. E. (Battelle Memorial Inst., Columbus). Weld. J. (N.Y.), 47: 497s-514s(Nov. 1968).

A study was conducted to develop electron-beam-welding procedures for several grades of beryllium $\frac{1}{16}$ to $\frac{3}{4}$ in. thick, using a 9 kW, 30 kV electron-beam welding machine. Weld quality was enhanced by a low beryllium-oxide content in the base metal and a minimum welding-energy input. High travel speeds created undesirable fusion-zone grain structures. Tensile-strength efficiencies of single-pass welds in $\frac{1}{16}$ and $\frac{1}{8}$ in. thick SR-200-C beryllium were 60 to 95% over a temperature range of 72° to 800°F. Elongations were low. Machining the weld surfaces raised the strength efficiencies but not the elongations. Welding procedures were developed for lap, tee, and corner joints although these joint configurations promoted weld cracking. Butt welds between sheets of unequal thickness were made. Ingot sheet beryllium was readily welded provided that the metallic impurity content of the base metal was not high enough to cause weld cracking. Transverse-weld bend transition temperatures were 880°F in $\frac{1}{16}$ in. thick ingot sheet and 1105°F in $\frac{1}{8}$ in. thick sheet. Tensile strength efficiencies were 40 to 75% at room temperature and nearly 100% at 800°F. Procedures were developed to weld $\frac{1}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{3}{4}$ in. thick beryllium using aluminum filler metal additions. Room-temperature strength efficiencies greater than 70% were obtained. Extensive metallographic studies were conducted to characterize the weld and base-metal structures. (auth)

3037 PROGRESS IN CASTING TECHNIQUES FOR BRONZES AND LOW-ALLOY COPPERS. Koumani, Georges. Cuivre, Laitons, Alliages, 101: 13-19(Jan.-Feb. 1968). (In French).

Vertical, semi-vertical, and horizontal continuous-casting equipment, techniques, and products are described and compared, with special reference to Sn bronze. The relatively simple machines and methods suitable for these are, however, impracticable with, for instance, Cu-Be, Cu-Co-Be, Cu-Cr-Zr, and Cu-Ni-Si alloys, for which finish-forging of centrifugally cast semi-products is suggested. Properties and applications of the alloys are tabulated and discussed. (tr-auth)

3038 COMMERCIAL CAPABILITY TO PROCESS AND FABRICATE NUCLEAR FUELS (CHART). Washington, D. C., Division of Industrial Participation, 1968. 1p.

Available Free from Division of Industrial Participation, AEC.

A chart is presented which designates the existing and future commercial capabilities of 17 US companies to fabricate and process nuclear fuels, materials for nuclear fuels, and materials from nuclear fuels. (L.C.L.)

3039 PURIFICATION OF IRON AND ZIRCONIUM BY ZONE TRANSFORMATION IN AN ATMOSPHERE OF HIGH PURITY. Alloud, P.; Langeron, J. P. (Centre d'Etudes de Chimie Metallurgique, Vitry, France). Mem. Sci. Rev. Met., 65: Spec. No., 73-84(June 15, 1968). (In French).

The zone transformation method of purification was tested on α iron by displacement of a γ zone and on zirconium by displacement of a β zone. The techniques used and the installation are described in detail. The zone transformation is carried out under purified argon. The application of the process to the purification of Fe and Zr is described. The similarities and differences in the zone transformation purification of Fe and Zr are interpreted with respect to the concentration in different impurities at equilibrium in the two phases, homogenization of the transformed zone, and non-homogenization of the rest of the rod. The results showed the possibilities of this procedure, in which the lack of a need for a boat, the lower temperature, and the independence on the dimensions of the rod are among the advantages. The results indicated that Fe is less suitable to zone transformation processing than Zr. In Zr there is a significant segregation of oxygen and nitrogen in the head of the rod. More than 90% of the length of the rod is purer than the original metal. The purification of argon by Ti-Zr 50-50 turnings is calculated. (J.S.R.)

3040 PROCESS FOR OBTAINING Al-Al_2O_3 STRUCTURES FOR NUCLEAR APPLICATIONS. Gualandi, Dante; Jehenson, Pierre (to EURATOM). U. S. Patent 3,394,000. July 23, 1968. Priority date Mar. 30, 1965, Italy.

A method for producing sintered Al-Al_2O_3 products for nuclear applications, comprises grinding of aluminum in the presence of a silicone, such as a silicone grease, and in an atmosphere which is maintained at a constant temperature, oxygen, and humidity level. (auth)

3041 TUNGSTEN-RHENIUM ALLOYS. Maykuth, Daniel J.; Bergeron, Elmo P.; Pearson, John H. (to Allied Chemical Corp.). U. S. Patent 3,399,981. Sept. 3, 1968. Filed Apr. 25, 1967.

Alloys of tungsten and rhenium in the form of particles having a microstructure consisting essentially of from 0.5 to 25.0% by weight of rhenium are prepared by vapor phase reduction of tungsten hexafluoride and rhenium hexafluoride. The alloys may be worked into products useful in rocket components. (auth)

3042 A.C. ETCHING OF PLUTONIUM. Johnson, Kaye Allan (to United States Atomic Energy Commission). U. S. Patent 3,413,200. Nov. 26, 1968.

A method of etching plutonium in which alternating current is passed through an electrolytic solution containing an inorganic acid is described. The plutonium is used as one of the electrodes. (AEC)

Properties Evaluations

Refer also to abstracts 2513, 2536, 3034, 3041, 3092, 3104, 3557, and 4308.

3043 (CONF-680448-2) BASIC STRENGTHENING MECHANISMS IN REFRACTORY METALS. Wilcox, B. A. (Battelle Memorial Inst., Columbus, Ohio). [1967]. 51p. Dep. CFSTI.

From Symposium on the Metallurgy and Technology of Refractory Metal Alloys, Washington, D. C.

The various strengthening mechanisms which have been used in producing strong refractory metal alloys are treated. The examples used to illustrate the various mechanisms were, by and large, based on simple systems. It is obvious, of course, that implementing more than one mechanism can produce combined strengthening effects, and this procedure has been common practice in refractory metal alloy development. An example of this is seen in the case of the strong Ta-base alloy, Ta-7W-1Re-1Hf-0.012C-0.012N. W and Re are added as solid-solution strengtheners. A portion of the Hf is in solution and the remainder combines with the C and N to form the precipitate Hf(C,N). This precipitate together with Ta_2C particles, contributes to the strengthening. If the alloy is tensile tested in the wrought-stress-relieved condition, the yield and ultimate strengths are higher than in the recrystallized condition. This follows because of the higher dislocation density and smaller effective grain size in the wrought material. A phenomenological equation is presented which contains, in functional form, the important parameters that can be varied to increase the strength of refractory metals: $\sigma = \sigma_0 + f(Gb/\lambda) + f\left[(1/a)(da/dc)\right] + f\left[(1/G)(dG/dc)\right] + \sigma_{SRO} + f(GbN) + f(d^{-}) + f(\sigma_f V_f)$. Increasing the strength, σ, can thus be accomplished by: (a) Incorporating small second phase particles spaced closely together (small λ). Particles (and small voids or bubbles) can also contribute indirectly to strengthening by helping to develop and/or pin a stable elongated grain and subgrain structure. (b) Solid solution alloying to (1) increase the

alloy shear modulus, G, (2) increase the absolute magnitude of the atomic misfit parameter (1/a) (da/dc), (3) increase the absolute magnitude of the modulus difference parameter (1/G) (dG/dc), (4) promote short range ordering, and (5) lower the high temperature alloy self-diffusivity, which in turn retards recovery and recrystallization. (c) Mechanical working to increase the dislocation density, N, or decrease the effective grain size, d. (d) Adding strong fibers (high σ_f) in conveniently high volume fractions, V_f. (auth)

3044 (GEAP-5653) STATUS OF PIPE-RUPTURE STUDY AT GENERAL ELECTRIC. II. Vandenberg, S. R. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). July 1968. Contract AT(04-3)-189. 60p. Dep. CFSTI.

Activities during the initial 3 years of a broad program are described concerning reliability engineering of reactor piping systems, solution of heretofore intractable problems in stress analysis, fracture mechanics, fatigue studies through bench-scale and large-component tests, and at-reactor tests of the effects of primary coolant environment on the fatigue life of primary piping steels. (auth)

3045 (KFK-774) TIME-STATE BEHAVIOR AND CREEP BEHAVIOR OF V-Ti AND V-Ti-Nb ALLOYS. Boehm, H.; Schirra, M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). June 1968. 60p. (In German). (EUR-3954). Dep.

The time-state behavior and the creep behavior of the binary V-Ti and ternary V-Ti-Nb alloys were studied in the temperature region over 650°C. The results show the preponderant effect of Ti on the time-state and creep behavior of the alloys. At Ti contents over about 1% the time-state stability decreases with increasing Ti concentration, but the short-term heat stability increases. This is independent of the Nb content. With increasing concentration of Nb, the life was increased, however, the effect of the Nb with increasing life was slight so that the $\sigma_{B/10,000}$ value was only slightly dependent on the Nb content. The best V alloys show long-time stabilities which can scarcely be attained by other materials. The activation energy of the creep in the temperature range about 650° shows a strong dependence on the Ti content, whereas the Nb content is without effect in this region. The results indicate that the time-state behavior and creep behavior of the alloys is also determined at high Ti content by the interaction between Ti and the interstitial impurities. (tr-auth)

3046 (N-68-27667) DEVELOPMENT OF A Co-W FERROMAGNETIC, HIGH-TEMPERATURE, STRUCTURAL ALLOY. Ashbrook, R. L.; Hoffman, A. C.; Sandrock, G. D.; Dreshfield, R. L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1967. 10p. (NASA-TM-X-52331; CONF-670921-4). CFSTI.

From International Congress on Magnetism, Boston, Mass.

Discussed is the development of alloys with improved high temperature strength and good high temperature magnetic properties for rotors used in space power generators. Because Co has the highest Curie temperature of any metal and is a good base for high temperature alloys, a NASA superalloy, Co-25-1 Ti-½ Zr-½ C, was chosen for further study. Modifications of this alloy were screened for magnetic induction (H = 100 Oe) over a range of temperatures. For increasing W, Curie temperature decreased for the base Co-XW-1 Ti-½ Zr-½ C, and B_{max} above 1000°F decreased. Below 1000°F, low W alloys show B_{max} vs T inflections due to instability of the fcc phase. Stability of the fcc increased with increasing W and Fe. A preferred alloy, Co-7-½ W-2-½ Fe-1 Ti-½ Zr-½ C, was evaluated for magnetic and mechanical properties in cast form and for mechanical properties as sheet. After aging at 1700°F for 72 hours, this alloy had a coercive force of 10.5 Oe at 75°F, and a B_{max} of 11.5 kilogauss and 19.3 kilogauss at 1200° and 1400°F, respectively. The stress rupture life at 1200 to 1400°F was greater than the strongest high-temperature commercially available magnetic-structural alloy. (STAR)

3047 (ORO-3604-3) DENSITY DETERMINATIONS USING A GAMMA RADIATION ATTENUATION TECHNIQUE. Annual Progress Report No. 2, January 1-August 31, 1967. Dillon, I. G. (Tuskegee Inst., Ala. School of Engineering). Sept. 30, 1968. Contract AT(40-1)-3604. 18p. Dep. CFSTI.

A review is given of activities and accomplishments, in 1967, on a program to develop a method for determining densities of coexisting vapor and liquid phases of alkali metals by use of gamma irradiation attenuation techniques. (P.G.C.)

3048 (RISO-184) COMPUTER SIMULATION OF THE PLASTIC DEFORMATION IN FACE-CENTRED CUBIC POLYCRYSTALS AND THE ROLLING TEXTURE DERIVED. Leffers, T. (Danish Atomic Energy Commission, Risoe. Research Establishment). July 1968. 33p. Dep.

The fcc rolling texture developed by {111} ⟨110⟩ slip is calculated by computer simulation of the plastic deformation. The computer program permits the use of different models for the deformation. In one extreme model the grains are assumed to deform like isolated single crystals. The other extreme is a model fulfilling Taylor's requirement that the deformation of the individual grains should correspond to the macroscopic deformation. The model in which the grains are considered to be isolated single crystals leads to a calculated texture of the brass type. A calculated copper-type texture is developed when the Taylor condition in which the microscopic and macroscopic deformation correspond, is partly fulfilled. Thus, both types of rolling texture found experimentally may be developed by {111} ⟨110⟩ slip. A dislocation model for the deformation during rolling of fcc polycrystals is proposed. The transition from brass-type to copper-type texture is ascribed to the pile-ups of screw dislocations being dispersed by cross-slip. (auth) (Denmark)

3049 ELASTIC CONSTANTS OF MOLYBDENUM-RICH RHENIUM ALLOYS IN THE TEMPERATURE RANGE -190°C TO +100°C. Davidson, D. L.; Brotzen, F. R. (Rice Univ., Houston, Tex.). J. Appl. Phys., 39: 5768-75(Nov. 1968).

The adiabatic elastic constants of molybdenum alloyed in solid solution with 7.0, 16.6, and 26.9 at. % rhenium were measured at -190 to +100°C. Rhenium additions decrease $(c_{11} - c_{12})/2$ and the twinning shear $(c_{11} - c_{12} + c_{44})/3$, and increase the bulk modulus and c_{44}. The 26.9 at. % alloy is elastically isotropic. Alloy additions strengthen nearest-neighbor interactions and weaken second-nearest-neighbor interactions. Debye temperatures calculated from the measured elastic constants agree well with those determined by calorimetry. Thermal expansion of the alloys was found to be essentially the same as for molybdenum in this temperature range. (auth)

3050 THE ELASTIC CONSTANTS OF POLYCRYSTALLINE HoZn. Michel, D. J.; Ryba, Earle; Chang, Z. P. (Pennsylvania State Univ., University Park). J. Appl. Phys., 39: 5547-8(Nov. 1968).

The elastic constants of polycrystalline $HoZn_2$ were determined in the 90 to 298°K region by ultrasonic techniques. The constants $C_{11} = \rho V_L^2$ and $C_{44} = \rho V_S^2$ vary with temperature in a linear manner and were extrapolated to 0°K by a least-squares fit to the data to give 1.118×10^{12} and 0.322×10^{12} dyn/cm^2, respectively. The Debye temperature for $HoZn_2$ was calculated to be 243°K at 0°K; the bulk modulus and Young's modulus at 298°K are 0.643×10^{12} and 0.765×10^{12} dyn/cm^2, respectively. (auth)

3051 METAL FILMS SPUTTERED AT LOW VOLTAGES. Lee, William W. (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Appl. Phys., 39: 5366-8(Nov. 1968).

Tantalum films sputtered at low voltages possess abnormally high resistivity. When the investigation was extended to other metals, many films exhibited electric properties similar to those of tantalum. The high resistivity was found not to be caused by residual oxygen or water vapor in the sputtering system, but by the microcrystalline structure of the films. An explanation of the particular properties exhibited by films of these materials is proposed. (auth)

3052 DEVELOPMENT OF VANADIUM ALLOYS FOR LMFBR CLADDING. Begley, R. T. (Westinghouse Astronuclear Lab., Pittsburgh); Bishop, E. C.; Buckman, R. W.; Nadler, R. A.; Whitlow, G. A. Trans. Amer. Nucl. Soc., 11: 501-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3053 FUSION CURVES FOR GRAPHITE, TUNGSTEN, AND PLATINUM UP TO 60 KBARS. Vereshchagin, L. F.; Fateeva, N. S. (Inst. of High-Pressure Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 1145-52(1968). (In Russian).

Fusion curves are measured for graphite up to 60, for tungsten up to 50, and platinum up to 40 kbars. The measurements are performed by an optical technique with allowance for temperature radiation. The results of the measurements are in good agreement with those obtained by the thermal analysis method (platinum). The agreement is not good for data obtained by electric measurements (graphite). The effect of increase of fusion temperature on pressure is found to be quadratic for graphite and linear for tungsten and platinum. (tr-auth)

3054 MECHANICAL PROPERTIES OF POLYCRYSTALLINE ERBIUM FROM 77° TO 750°K. Owen, C. V.; Scott, T. E. (Ames Lab., Iowa). J. Less-Common Metals, 16: 447-55(1968).

The flow-stress temperature dependence, strain-rate sensitivity, strain-hardening exponent, and ductility of erbium were determined from 77 to 750°K at strain rates of 0.002, 0.01, 0.1, and 1.0 min^{-1}. The results are presented and comparisons of the properties of

erbium with those of other low-c/a lattice ratio hcp metals are discussed. (auth)

3055 LE FER DE TRES HAUTE PURETE. PROPRIETES PHYSIQUES ET CHIMIQUES, PARIS, 26–30 SEPTEMBRE 1966. (International Symposium on Physical and Chemical Properties of Iron of High Purity, Paris, September 26–30, 1966). Mem. Sci. Rev. Met., 65: Spec. No., 1-436(June 15, 1968). (In French and English). (CONF-660965).

Separate abstracts were prepared for six of the forty-nine papers presented. The remaining papers were grouped in the following categories: analysis of high-purity iron; methods of purification; resistivity and control of iron purity; magnetic properties of high-purity iron; point defects in iron; mechanical properties of high-purity iron; the dislocations in iron; recrystallization of high-purity iron; corrosion of high-purity iron and high-purity stainless steels; and the metalloids in high-purity iron. (D.H.M.)

For abstracts of individual papers see: 2236, 3039, 3056, 3057, 3102, and 3103.

3056 STRAIN AGING AND RECOVERY BEHAVIOUR OF Fe–Cr AND Fe–Mo ALLOYS. Mould, P. R.; Smith, G. V. (Cornell Univ., Ithaca, N. Y.). Mem. Sci. Rev. Met., 65: Spec. No., 271-4(June 15, 1968).

From International Symposium on the New Physical, Mechanical and Chemical Properties of High Purity Iron, Paris, France. See CONF-660965.

The influence of Cr and Mo additions on the recovery behavior of iron is investigated. Samples initially strained 10% at room temperature of iron, Cr–Fe, and Fe–Mo were annealed for 2 hrs at room temperature to 650°C and the change in flow stress obtained. Results in terms of an interaction of interstitials are proposed. (J.C.W.)

3057 A COMPARISON OF THE DEFORMATION CHARACTERISTICS OF ZONE REFINED NIOBIUM AND TANTALUM WITH HIGH PURITY IRON. Thomas, Marshall K. Jr. (Naval Air Engineering Center, Philadelphia). Mem. Sci. Rev. Met., 65: Spec. No., 265-9(June 15, 1968).

From International Symposium on the New Physical, Mechanical and Chemical Properties of High Purity Iron, Paris, France. See CONF-660965.

The critical resolved shear stress (CRSS) and yield point are examined in high purity single crystal iron, niobium, and tantalum as a function of temperature, orientation, purity, and substructure. The CRSS varies with orientation for iron, niobium, and tantalum. The pattern of this variation is not clear but is a function of temperature. Reducing impurities lowers the CRSS in all cases and decreases the temperature dependence in iron but not in niobium. The purity of iron and the orientation of niobium and tantalum determine whether the mode of deformation changes with decreasing temperature. The temperature dependence of the yield point in tantalum was shifted by varying the speed of zone refining, which probably altered its substructure. (J.C.W.)

3058 SUPERSONIC FLAW-DETECTION METHOD FOR ZIRCALOY CLADDING TUBES. Niwa, Noboru; Ishida, Yasukazu (Atomic Fuel Corp., Tokyo). Hihaki Kensa, 16: 469-71(Nov. 1967). (In Japanese).

A sonic flaw-detection method for nondestructive testing of water reactor fuel cladding tubes is described. Use of the method for Zircaloy fuel cladding is discussed. (NSA of Japan)

3059 EFFECTS OF HYDROSTATIC PRESSURE ON THE MECHANICAL BEHAVIOR OF POLYCRYSTALLINE BERYLLIUM. Inoue, N. (Franklin Inst. Research Labs., Philadelphia); Damiano, V.; Hanafee, J.; Conrad, H. Trans. Met. Soc. AIME, 242: 2081-9(Oct. 1968).

The effects of hydrostatic pressure up to 400 ksi at 25 to 300°C on the mechanical properties of three forms of commercial beryllium (hot-pressed block, extruded rod and cross-rolled sheet) were investigated. Three effects of pressure were studied: mechanical behavior under pressure, the effect of pressure-cycling, and the effect of tensile prestraining under hydrostatic pressure on the subsequent tensile properties at atmospheric pressure. For all three materials the ductility increased with pressure whereas the flow stress did not appear to be significantly influenced by pressure. An increase in the subsequent atmospheric pressure yield strength generally occurred as a result of pressure-cycling or prestraining under pressure, whereas either no change or a decrease in ductility occurred. The only exception to this was sheet material, which exhibited some improvement in ductility following a pressure-cycle treatment of 304 ksi pressure. The effects of pressure-cycling and prestraining were relatively independent of the temperature at which they were conducted. Stabilized cracks of the (0001) type were found in hot-pressed specimens and $\{11\bar{2}0\}$ type in extruded and sheet specimens following straining under pressure. Also, pyramidal slip with a vector out of the basal plane, presumably c + a, was identified by electron transmission microscopy for extruded rod and for sheet strained under pressure. Small loops similar to those previously reported were found after straining at pressures of the order of 300 ksi. (auth)

3060 DIFFUSION OF NICKEL DURING NICKEL-INDUCED RECRYSTALLIZATION IN DOPED TUNGSTEN. Friedman, S.; Brett, J. (General Telephone and Electronics Labs., Bayside, N. Y.). Trans. Met. Soc. AIME, 242: 2121-7(Oct. 1968).

A study of the diffusion of nickel into both fibrous and recrystallized 0.065-in.-dia silica-alumina doped tungsten wire at 1200°C has been conducted. The diffusion profiles were determined by chemical dissolution of successive circumferential layers and spectrophotometric determination of nickel in the etchant. It was shown that the diffusion of nickel into tungsten is markedly structure-sensitive. No significant amount of nickel could be introduced at 1200°C into tungsten which had first been recrystallized at temperatures of 2300°C, leading to an upper limit estimate for the bulk diffusivity of nickel in tungsten of 10^{-11} cm^2 per sec at 1200°C. However, nickel did diffuse into initially fibrous wires, caused recrystallization, and was always present at the advancing recrystallization front. The accumulation of nickel in an initially fibrous region ceases when the recrystallization front arrives. The characteristics of the resulting diffusion profiles are explained in terms of the relation between diffusion processes and microstructural changes. (auth)

3061 SUPERPLASTICITY. Backofen, Walter A.; Azzarto, Francis J.; Murty, G. S.; Zehr, Stanley W. pp 279-310 of Ductility. Metals Park, Ohio, American Society for Metals, 1968.

From American Society for Metals Seminar on Ductility, Cleveland, Ohio. See CONF-671051.

A discussion of the mechanisms of superplasticity in metals with suggestions for using this property to improve strength and toughness of metals and its possible use in sheet metal forming operations. (P.G.C.)

3062 EFFECTIVE DUCTILITY IN CASTINGS AND WELDMENTS. Adams, Clyde M. Jr. pp 179-97 of Ductility. Metals Park, Ohio, American Society for Metals, 1968.

From American Society for Metals Seminar on Ductility, Cleveland, Ohio. See CONF-671051.

An analysis is given of the causes of failures, under stress, of mild steel, tool steel, WC, and Al alloys welded by tungsten inert gas, electron beam, or short circuiting arc methods with various types of fillers. It is concluded that effective ductility in castings and weldments is a consequence of circumstances which include but are not limited to the properties of the basic materials. (P.G.C.)

3063 DUCTILITY IN CREEP. Garofalo, F. pp 87-132 of Ductility. Metals Park, Ohio, American Society for Metals, 1968.

From American Society for Metals Seminar on Ductility, Cleveland, Ohio. See CONF-671051.

The mechanisms of creep rupture strength in commercial alloys for high-temperature service are discussed from the viewpoint of the several modes of deformation. Results of studies of creep deformation in bicrystals and polycrystals are reported as are the mechanics of intergranular deformation, crack initiation and growth, grain boundary sliding and migration, and the dependence of creep ductility on stress, temperature, composition, microstructure, and environment. (P.G.C.)

3064 PRECIPITATION HARDENING OF Co–Cr–Ta ALLOYS. Drapier, J. M. (Centre National de Recherches Metallurgiques, Liege. Univ., Liege); Coutsouradis, D. Cobalt, [17]: 63-74 (June 1968).

An investigation aimed at stabilizing the microstructure of the Co–8% Cr–10% Ta alloy at temperatures above 700°C by modifying the alloy composition is described. To this end the effect of Ti, Al, and V additions, capable of either stabilizing the α–Co_2Ta phase or forming additional intermetallic compounds with cobalt, was studied, together with the possibility of stabilizing the fcc solid solution by means of Ni additions. The effect of simultaneous precipitation of inter-metallic compounds and stable carbides was also investigated. The observed strengthening of alloys containing 7.7% Ta–2.25% V and 15% Ta–20% Ni, respectively, was attributed to the precipitation of the ordered fcc α–Co_2Ta compound as fine coherent particles. The result of the vanadium additions is to stabilize the hardening effect up to 800°C. A nickel addition first ensures greater stability of the fcc matrix; with a suitable ratio of the Ta and Ni initial contents, it also gives rise to the

formation of the rhombohedral compound $\beta-Co_3Ta$ in the {111} planes of the matrix. (IAA)

3065 THERMAL PROPERTIES OF Mo MONOCRYSTALS AT ELEVATED TEMPERATURES. Khusainov, B. N.; Filippov, L. P. (Moscow State Univ.). Teplofiz. Vys. Temp., 6: 929-30(Sept.-Oct. 1968). (In Russian).

Results of measurements of thermal conductivity, thermal capacity, and electric conductivity of Mo monocrystals at 450 to 1200°K were analyzed and correlated with published data. (R.V.J.)

3066 INTERDIFFUSION BETWEEN TANTALUM AND TUNGSTEN. Tregubov, I. A.; Kuzina, I. A.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 180: 423-4(1968). (In Russian).

To determine the coefficient of interdiffusion between tungsten and tantalum, ground specimens of tungsten and tantalum in contact at a pressure of up to 10 kg/cm^2 were held in a vacuum of 2×10^{-3} mm Hg at 2000°C for 48 hr. The diffusion coefficient of tantalum was found to depend on the tungsten content in the interface diffusion layer. The value of the diffusion coefficient of tantalum sharply decreased from 4.7×10^{-11} to 0.8×10^{-11} cm^2/sec with increasing tungsten content from 10 to 50 wt %, and gradually increased from 0.8×10^{-11} to 1.9×10^{-11} cm^2/sec with increasing tungsten content from 60 to 90 wt %. The interdiffusion coefficient had a minimum value at a tungsten content of 40 to 60 wt %. (ATD)

3067 COMPUTED AND EXPERIMENTAL MAGNITUDES OF Mo-Nb ALLOY CONDUCTANCE. Savitskii, E. M.; Burov, I. V.; Pirogova, S. V. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 182: 562-4(Sept. 21, 1968). (In Russian).

Constitution diagram and conductance curves were constructed for monocrystals of the Mo-Nb system at 293, 77, and 4.2°K. Tabulated data are included on the conductance magnitudes for Mo-Nb system with various at. % Nb content (from 0 to 100). (R.V.J.)

Structure and Phase Studies

Refer also to abstracts 3019, 3041, and 3092.

3068 (ANL-Trans-683) CORRELATED AND UNCORRELATED DIFFUSION VIA EDGE DISLOCATIONS. Wever, H.; Adam, P.; Frohberg, G. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Acta Met., 16: 1289-95(Oct. 1968). 13p. Dep. CFSTI.

Two distinct mechanisms must be considered in connection with an accelerated diffusion via edge dislocations in metals, an uncorrelated interstitial mechanism and a correlated vacancy mechanism. The proportion associated with the interstitial mechanism and the correlation factor for the vacancy mechanism are estimated. It is found that the interstitial mechanism can be important only for metals with a very high stacking fault energy. The correlation factor for the vacancy mechanism is an exponential function of the temperature and it follows that the activation energies generally differ for a correlated and uncorrelated transport via dislocation pipes: the difference is all the more pronounced, the more the accelerated diffusion is limited to the dislocation core. (auth)

3069 (CEA-R-3498) INFLUENCE OF BORON ON ALPHA CRYSTALLIZATION OF URANIUM ALLOYS. Foure, Michel; Lauque, Jean-Pierre; Colombie, Michel; Decours, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1968. 36p. (In French). Dep.

Results are presented of research in alpha crystallization of uranium alloys. An addition of small quantities of boron produces an important refining of alpha grains for very small cooling rates (about 10 to 20°C/minute). This refining is attributed to the presence of UB_2 boride precipitation, acting as heterogeneous germs during the beta → alpha transformation. This action is the more important, as boride dispersion grows thinner. After a thorough study of alloys with small contents of molybdenum (0.2 to 0.4% Mo) and an addition of 100×10^{-6} of boron during isothermal and/or continuous cooling, a description is given of the refining obtained for different alloys with very small contents (U-Si, U-Cr, U-Mo-Al, U-Mo-Si, U-Mo-Sn, etc...) and even for technical uranium, under condition, that the boride precipitation is very thinly dispersed. Additions of very small quantities of boron do not sensibly modify the mechanical properties. (auth)

3070 (CEA-R-3529) COMPLEMENTARY OBSERVATIONS CONCERNING CAST GRAIN REFINING IN URANIUM ALLOYS. INFLUENCE OF SMALL ADDITIONS. Colombie, Michel; Decours, Jacques; Foure, Michel; Magnier, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). July 1968. 25p. (In French). Dep.

The advantages of refining the primary γ crystallization in uranium and its alloys are presented. The refining or the control of the γ grains can be obtained either by modifying the solidification kinetics, or by the addition of very small amounts of alloying elements. The second method is considered and particular attention paid to the refining role played by elements of low atomic number. The presence of carbon in concentrations of less than 1000×10^{-6} in U-Mo alloys leads to a definite refining effect on the primary γ crystallization. For a given rate of solidification, this effect is a maximum for a carbon content of between 500 and 800×10^{-6}. The importance of this maximum decreases with the cooling rate; it is very marked for fast rates and disappears in the case of low cooling rates. The addition of carbon gives rise to the formation of uranium carbides whose nature and dispersion state depend on the solidification kinetics. The grain refinement mentioned above depends both on the temperature of formation of these precipitates, i.e., the equilibrium diagram, and on their size. A mechanism is proposed for interpreting the various observations. Boron has a still faster action than that of the carbon, even in the case of much lower concentrations. This addition of boron leads to the formation of boride whose morphology has been related to the equilibrium diagram and to the solidification process. The simultaneous addition of boron and of carbon leads to a larger relative refining than that corresponding to only one of these elements. A systematic search has been carried out among the elements having a low atomic diameter. Oxygen and sulfur, among others, proved to have no effect; beryllium and phosphorus, on the other hand, displayed a definite ability to refine the grains. This effect is studied in detail in the case of beryllium. (auth)

3071 (JUL-527-FN) THEORY OF THE KIRKENDALL EFFECT. Schlipf, Josef (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerper- und Neutronenphysik). May 1968. 53p. (In German). Dep.

Thesis. Submitted to Technische Hochschule, Aachen, Ger.

In variation from the ideal Kirkendall effect described by the Darken equations, a theory of the real Kirkendall effect was derived. The real Kirkendall effect exists not only in the migration of the original separation plane, but is characterized by large deviations from the vacancy equilibrium, plastic deformation, pore formation, and unexpected signaling displacement. In the phenomenological part an approximation method was given which permits the vacancy concentration and the displacement rate in the diffusion zone to be calculated explicitly with good approximation. It was shown that in Ag-Au diffusion pairs, deformation zones occur on the external boundary of the diffusion zone, which indicates an induced Kirdendall effect of the same order of magnitude as the diffusion zone. The deformation zone can be described as sites of abnormally high vacancy production. A concentration drop is constantly maintained in which the vacancies diffuse out and are then annealed. From the distance between production and annihilation maxima, the range of the vacancies can be determined. A range in Au of about 25 μ was attained, which corresponds to a lifetime of about 10^{10} transposition. In the physical part of the theory it was shown that the plastic deformation plays a decisive roll in the causing of the Kirkendall effect. The size of the plastic deformation in the total concentration region was calculated, in which a simple relation between the displacement rate of signals and the deformation rate was given. Hypotheses and mechanism of the formation of deformation zones were explained, especially the effect of the inhomogeneity of the diffusive deformation. The deformation zones were traced back to the formation of microfissures in the diffusive deformation, which are so small that they are evaporated by formation of a vacancy cloud. The relation of fissuring and pore formation was investigated and in agreement with experiment it was found that pore formation in metals without oxide inclusions occurs only at the beginning of the diffusion. (tr-auth)

3072 (UCRL-50525) ACOUSTIC EMISSIONS GENERATED DURING PHASE TRANSFORMATIONS IN METALS AND ALLOYS. Liptai, R. G.; Dunegan, H. L.; Tatro, C. A. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 6, 1968. Contract W-7405-eng-48. 9p. Dep. CFSTI.

Phase transformations in metals and alloys usually are grouped in one of two general categories: nucleation-and-growth, or martensitic (shear) transformations. The choice depends on the atomic mechanism involved in the transformation. Unlike the nucleation-and-growth process, which involves thermal activation and diffusion, martensitic transformations are diffusionless reactions characterized by cooperative movements of atoms through small distances relative to neighboring atoms. Acoustic emissions are the stress waves or lattice vibrations that are generated during these shear-like reactions. Emission analysis has been used for

material evaluation and for characterization of martensitic transformations. Experiments were conducted with gold–47.5 at. % cadmium, indium–22 at. % thallium, cobalt, and plutonium. The use of emission analysis and the experimental results is discussed. Metallurgical processes other than martensitic phase transformations can generate acoustic emissions. Emission analysis of these processes for material evaluation is also discussed. An electrosonic technique is used to detect acoustic emission in the frequency range between 90 to 200 kHz. The electronic equipment (for example, lead–zirconate–titanate sensing transducer, amplification and recording apparatus) and the experimental techniques are described. (auth)

3073 AN ELECTRON-DIFFRACTION STUDY OF THE γ PHASE IN THE Ta–O SYSTEM. Klechkovskaya, V. V.; Khitrova, V. I. (Inst. of Crystallography, Moscow). Sov. Phys.-Cryst. (Engl. Transl), 13: 428-30(Nov.-Dec. 1968).

Translated from Kristallografiya, 13: 523-6(May-June, 1968).

An fcc phase with a = 4.38 Å was produced by evaporation from a metal plate on to a NaCl crystal at 10^{-5} to 10^{-6} mm Hg. Table of the comparisons of observed and theoretical structure amplitudes for the phase with a = 4.38 Å and the observed and calculated structure amplitudes for the phase with a = 4.44 Å are given. Interatomic distances in the structures with a = 4.38 and 4.44 Å are tabulated. (J.C.W.)

3074 NEW INTERMEDIATE PHASE IN Co–Nb ALLOY. Kokorin, V. V.; Chuistov, K. V. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved., 26: 375-6(Aug. 1968). (In Russian).

Phase analysis of electrolytically precipitated Co–Nb powders annealed at 850°C revealed a new phase with an ordered structure similar to the Cu_3Au type. The phase has a similar lattice to β phase matrix lattice and was named the β' phase. X-ray studies of the crystalline lattice of the phase of the powder prepared by annealing for one hour at 800°C was equal to a = 3.654 ± 0.005 Å. (R.V.J.)

3075 PREPARATION OF RHENIUM FOR TRANSMISSION ELECTRON MICROSCOPY. Carpenter, R. W.; Paris, H. G. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 39: 5809-10 (Nov. 1968).

A method is needed for thinning only a small part of the total surface area of a disk cut from a cylindrical single-crystal Re rod. The controlled high-voltage jet-polishing method developed by DuBose and Stiegler was investigated. Of the electrolytes tested, an aqueous 3% NaOH solution produced a reasonably flat-bottomed dimple, and the optimum process parameters are given. Electrolyte flow is an important variable. Final polishing was performed in a 20 vol % perchloric acid–80 vol % ethanol bath at –40°C. (D.L.C.)

3076 INFLUENCE OF OXYGEN UPON INTERGRANULAR FRACTURE IN CAST TUNGSTEN. Blenkinsop, P. A.; Morton, P. H. (Imperial Metal Industries, Ltd., Birmingham, Eng.). J. Inst. Metals, 96: 248-?(1968).

The electron microscope was used to investigate the reasons for integranular fracture in cast tungsten containing oxygen. Carbon replicas taken from intergranular fracture surfaces revealed polyhedra that were identified as cavities at the grain boundaries of the original samples. Observations substantiate the theory that the cavities are formed by the condensation of oxide vapor at grain boundaries. (auth) (UK)

3077 CRYSTAL STRUCTURE AND LATTICE CONSTANTS OF $R.E._2In$ AND SOME $R.E._5In_3$ COMPOUNDS. Palenzona, A. (Univ., Genoa). J. Less-Common Metals, 16: 379-84(1968).

A new series of isomorphous compounds of composition $R.E._2In$ has been prepared by alloying rare earths with indium. The structure of these compounds corresponds to that of the Ni_2In type and is observed for all trivalent rare earths from La to Lu with the exception of Eu and Yb which do not form this phase. For Ho, Er, Tm, and Lu the phase $R.E._5In_3$ was additionally found; this phase has the Mn_5Si_3 type of structure which is closely related to that of Ni_2In. (auth)

3078 STUDY OF THE THERMAL CONDUCTIVITY OF POLYCRYSTALLINE AND SINGLE CRYSTALS OF TERBIUM BETWEEN 1 AND 4°K. Karagezyan, A. G.; Rao, K. V. Zh. Eksp. Teor. Fiz., 55: 1168-72(1968). (In Russian).

Anomalies in the thermal conductivity of polycrystalline and single crystal samples of terbium are observed at liquid helium temperature. Conductivity of a terbium single crystal in a magnetic field is measured to study magnetic anisotropy effects. The electric and thermal conductivity measurements yield for the Lorentz number is 2.55×10^{-8} W · ohm/degree^2 which is the smallest value ever observed for rare earth metals at 4.2°K. An attempt is made to explain the observed anomalies by phenomena related to the presence of impurities in the metals. (tr-auth)

3079 GROWTH AND MICROSTRUCTURE OF MOLYBDENUM OXIDE CRYSTALS. Vahldiek, F. W. (Air Force Materials Lab., Dayton, Ohio). J. Less-Common Metals, 16: 351-9(1968).

Molybdenum powder was heated in 1 atm argon containing oxygen and water at 1200 to 1400°C for up to 24 hr. Dendritic and needle-like crystals were grown in the cooler parts of the furnace at 700 to 900°C. X-ray and electron diffraction results showed these crystals, colorless or green in appearance, to be MoO_3 containing small amounts of MoO_2. Small particles of molybdenum oxide were studied for comparison by X-ray and electron diffraction techniques and identified to be a similar mixture of MoO_3 and MoO_2. Optical and electron microscopy showed spiral-type growth mechanism on the crystallites. Similar growth steps were observed in small particles of MoO_3–MoO_2. High temperature X-ray diffraction under vacuum up to 1155°C showed an increase of MoO_2 with a concomitant decrease in MoO_3. Above 1155°C, complete vaporization of the oxide layer was observed. Small particles, studied by high temperature X-ray diffraction in air, recrystallized into small dendritic and platelet-shaped crystals. These MoO_3 platelets contained precipitates and growth twins analyzed by electron diffraction were shown to be MoO_2. (auth)

3080 CALCIUM–YTTERBIUM SYSTEM. Soderquist, S. D.; Kayser, F. X. (Ames Lab., Iowa). J. Less-Common Metals, 16: 361-5(1968).

Specimens of calcium, ytterbium, and seven calcium–ytterbium alloys have been examined at 900 to 400°C by differential thermal analysis. The results indicate the existence of a minimum in the melting point near 75 at. % ytterbium. Equilibrium in the solid state is characterized by continuous body-centered cubic and face-centered cubic solid solutions at high and low temperatures, respectively. Metallographic examination of several of the alloys confirmed the existence of a solid solution at room temperature. The form of the electrical resistivity vs. composition curve obtained at 27°C is typical of a solid solution. (auth)

3081 PHASE EQUILIBRIA IN THE NICKEL–ALUMINIUM–SCANDIUM SYSTEM AT 1000°C. Goebel, J. A.; Rosen, S. (United Aircraft Corp., Middletown, Conn.). J. Less-Common Metals, 16: 441-6(1968).

The nickel-rich region of the Ni–Al–Sc system has been investigated, and a supplementary study made of the Sc–Ni system at 1000°C for alloys containing more than 50 at. % Ni. Emphasis was placed on the identification of solid phase equilibria, and some solid-solubility limits have been determined. A portion of the Ni–Al–Sc ternary diagram has been constructed, and three previously unreported phases (Sc_2Ni_7, $ScNi_5$, $AlScNi_2$) have been identified. (auth)

3082 INTERNAL VOID FORMATION IN POWDER METALLURGY TUNGSTEN. Das, G.; Radcliffe, S. V. (Case Western Reserve Univ., Cleveland). Trans. Met. Soc. AIME, 242: 2191-8(Oct. 1968).

The substructural features developed in tungsten as a function of annealing temperature (up to 2200°C) and type of material [undoped and doped powder metallurgy (PM) tungsten and electron beam melted tungsten] have been investigated by transmission electron microscopy. For doped PM tungsten wires, characteristic particulate substructural features developed rapidly with increase in annealing temperature above 700°C. The features consisted of parallel rows of elongated or circular shapes (500 to 1000 Å dia) lying along the direction of the wire axis and were identified as internal voids by diffraction contrast experiments. In recrystallized doped PM rod, larger voids were observed and were identified by precision dark field analysis to be cubic in shape and bounded by {100} planes. In marked contrast with both the doped PM materials, recrystallized undoped PM rod exhibited only very occasional and randomly arranged voids. Furthermore, no voids were observed in either material after electron beam melting. The high concentration of voids in the doped PM materials is attributed primarily to vaporization of doping additions or their products situated at the original grain boundaries, whereas the few voids in undoped material are considered to be traces of microporosity which were not eliminated during sintering. A tentative mechanism is suggested for the development of the voids in relation to the processing sequences (sintering and working) and to the subsequent annealing. (auth)

3083 DOUBLE ACCOMODATION KINKING AND GROWTH OF (1121) TWINS IN ZIRCONIUM. Reed-Hill, R. E.; Hartt, W. H.; Slippy, W. A. Jr. (Univ. of Florida, Gainesville). Trans. Met. Soc. AIME, 242: 2211-15(Oct. 1968).

An unusual form of double kinking has been observed at the ends of $\{11\bar{2}1\}$ twins in deformed zirconium. These kinks lie partly outside of the twin and partly inside. While they are undoubtedly closely associated with accommodating the twinning

shear into the matrix, they are apparently closely related to other important aspects of twin growth. A mechanism is proposed for $\{11\bar{2}1\}$ twin growth involving interactions between $\frac{1}{3}\langle 11\bar{2}0\rangle$ dislocations in the bend planes and twinning dislocations. It is also shown that boundaries without long range fields develop at the tapered ends of the twins. The $\{11\bar{2}1\}$ twins can, therefore, grow without forming high-energy noncoherent twin boundaries containing large numbers of closely spaced twinning dislocations. (auth)

3084 ON THE TRANSFORMATION OF $ZrCr_2$. Shen, Yuanshou (Wah Chang Corp., Albany, Oreg.); Paasche, O. G. Trans. Met. Soc. AIME, 242: 2241-2(Oct. 1968).

Heat treating experiments conducted to determine the manner of transformation of $ZrCr_2$ indicate that once the compound is transformed from the C-14 structure to the C-15 structure by heating above 900°C it will not transform from C-15 to C-14 even when slowly annealed passing 900°C even after slow cooling. From x-ray analyses it appears that a transition from C-15 structure at lower temperatures to the C-14 structure occurs between 1550 and 1600°C. (P.G.C.)

3085 CONTRIBUTION TO THE SYSTEM Fe–W–Zn. Matting, A.; Krueger, U. (Technische Univ., Hanover). Metall, 22: 992-4(Oct. 1968). (In German).

The selection of W as an electrode material in the point welding of galvanized sheets necessitates a more accurate knowledge of possible metallurgical reactions. In spite of a barrier layer of zinc and iron–zinc phases, a direct W–Fe contact in the presence of Zn appears possible. Photomicrographs of point-weld electrodes indicate the origin of intermetallic compounds. The binary systems Fe–Zn and Fe–W are known. An alloying of W–Zn was avoided because of the lack of solubility. With the help of a special sample form, annealing studies could be carried out at 1100°C in spite of the easily evaporated Zn. Structure, hardness, and microanalyses were evaluated. The presence of a ternary alloy 36% Fe–57% W–5% Zn appeared probable on the basis of the microline analyses. (tr-auth)

3086 EFFECT OF CYCLIC THERMAL TREATMENT ON THE FINE STRUCTURE OF TUNGSTEN SINGLE CRYSTALS. Savitskii, E. M.; Burkhanov, G. S.; Raskatov, N. N. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk. SSSR, 179: 115-18 (1968). (In Russian).

The effect of cyclic heat treatment on changes in the crystal structure of W single crystals was studied. The thermal cycling of W single crystals was conducted in a H atmosphere in an installation for H sintering of W moldings. It was equipped with a programmed device for automatic heat cycling in accordance with a preassigned schedule. The starting specimens were W single crystals 10 mm in diameter and 360 mm in length. They were obtained by electron beam zone melting in a vacuum without a N trap. The W crystals contained 0.02% C and 0.001% O. The specimens were heated by passing an alternating current through them. Each cycle comprised a temperature change of the order of 2500 to 1000°C. The rate of heating and cooling was approximately 1200 to 1500°C per min. It was found that cyclic heat treatment of W single crystals causes two parallel processes to take place: the process of multiplication and movement of dislocations as a result of plastic deformation under the influence of thermal stresses and annihilation of growth dislocations as a result of decarbonization of the material. At the rates of heating and cooling which were used the first process predominates. The average density of dislocations increases with an increase in the heat cycling time. The dislocations formed arrange themselves in the volume of the single crystal nonuniformly; accumulation of dislocations is observed in the form of clusters and bands. A 20-hr cyclic heat treatment leads to a decrease in the concentration of C in the W moldings and single crystals by a factor of three due to combination of C with the O impurity which exists in the medium. As a result of this the W embrittlement temperature decreases sharply. Further increasing the cycling time leads to the occurrence of qualitatively different processes. Cyclic heat treatment of W single crystals causes division of domains and results in their disorientation. Prolonged cyclic heat treatment (100 hr or more) produces a polycrystalline structure. The impurities and dislocations which are formed act as active centers for the formation of microcracks which develop further under the influence of thermal stresses. These effects were observed during cyclic heat treatment both in H and in He. Future investigation will be concerned with establishing conditions for heating the cracks which form during cyclic heat treatment and specifically the effect of annealing. (ATD)

3087 INVESTIGATION OF NONMETALLIC INCLUSIONS IN MOLYBDENUM AS A FUNCTION OF THE MEANS OF MELTING BY ELECTRON MICROSCOPE AND ELECTRON MICRODIFFRACTION METHODS. Ageev, N. V.; Ignatov, D. V.; Kantor, M. M.; Ivanovskii, G. F.; Zagorskaya, T. N. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR, 179: 1400-2(1968). (In Russian).

The starting material for the investigation was Brand MCh metallo-ceramic molybdenum with a carbon content of 0.02%. To study the effect of the purity of the starting molybdenum, some samples were of single crystals of molybdenum with a carbon content of approximately 0.005%. In addition, the starting billet for one of the samples was prepared by special purification: molybdenum trioxide was vaporized and deposited in vacuum on metallic molybdenum; then the molybdenum powder was reduced and pressed without addition of binders and sintered in a vacuum. In the zone melting, in reducing and oxidizing media, the sample was previously degassed at 600 to 700°C. The rate of movement of the zone was 0.8 mm/min. The results of an electron microscope investigation showed that single crystals of molybdenum obtained by zone melting in a vacuum of approximately 10^{-7} torr still contain a considerable number of carbide inclusions, some of them very large. Electron microscope investigation of a typical particle of such an inclusion had the lattice parameters of hexagonal molybdenum carbide. Thus, zone refining in a vacuum of 10^{-7} torr does not lead to complete purification of molybdenum from carbon. Single crystals of molybdenum zone melted in a hydrogen atmosphere showed approximately the same amount of inclusions of molybdenum carbide. However, zone melting in an atmosphere of oxygen produced inclusions having the lattice parameters of monoclinic molybdenum dioxide. In the latter case, there were also inclusions of molybdenum carbide. It is concluded that, using modern methods of purification, unalloyed molybdenum is a two-phase system, consisting of a solid solution of carbon in molybdenum. (ATD)

Radiation Effects

Refer also to abstracts 3585 and 4248.

3088 (AD–671094) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, February 1–April 30, 1968. Steele, L. E.; Hawthorne, J. R.; Serpan, C. Z. Jr.; Potapovs, Uldis (Naval Research Lab., Washington, D. C.). May 15, 1968. 41p. (NRL-MR-1872). CFSTI.

The determination of the effects of nuclear radiation on the properties of structural materials is reported. Research on the control of the radiation embrittlement sensitivity of Ni–Cr–Mo weld deposits by varying their chemical composition, influence of prior temper embrittlement on the irradiation response of Ni–Cr–Mo steel, relative 550°F irradiation response of base plate, weld metal, and weld heat affected zone of a 7½-in.-thick A533-B Class I production weldment, drop weight NDT versus Charpy-V energy absorption level in 6¾-in. Type A533 B Class I and II steel plate, and mechanical properties evaluation of PM-2A reactor pressure vessel steel is discussed. (USGRDR)

3089 (GEMP–581) RADIATION EFFECTS ON THE MICROSTRUCTURE OF TUNGSTEN. Rau, Robert C.; Moteff, John; Ladd, Robert L. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). [nd]. Contract AT(40-1)-2847. 4p. (CONF-680601–40). Dep. CFSTI.

From 14th Annual Meeting of the American Nuclear Society, Toronto, Ontario.

By transmission electron microscopy the microstructure of neutron irradiated W has been characterized as a function of neutron fluence and post-irradiation annealing temperature, and has been correlated with mechanical properties. (auth)

3090 (REIC-Access–113) MONTHLY ACCESSION LIST. Abstract No. 37943–38038, May 1–July 31, 1968. (Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center). Aug. 10, 1968. 59p. Dep. CFSTI.

Abstracts of unclassified articles acquired by the Radiation Effects Information Center Technical Information File during May 1 to August 1968 are presented. (L.C.L.)

3091 (TID–24772) GTR-16 RADIATION EFFECTS TEST ON STRUCTURAL MATERIALS AT -423°F. NERVA Program. Final Report. (Aerojet-General Corp., Sacramento, Calif.). Nov. 1966. Contract SNP-1. 197p. (RN-S-290). Dep. CFSTI.

Results of tests to determine the effects of nuclear radiation at liquid hydrogen environment on the mechanical properties of several materials considered for structural application in the NERVA and other nuclear propulsion systems are reported. The tests consisted of two consecutive 200-hour radiation runs. Tensile and shear tests were performed in accordance with the test specifications outlined in REON Report RN-S-0184. The third

scheduled type of test (thermal conductivity) was cancelled since problems during the control run were encountered with the test equipment. Materials tested include aluminum alloys A-356-T6, 6061-T6, 7075-T6; steels 347SS, A-286, 440C, 410SS; nickel alloys: Hastelloy C, Inconel X-750, Inconel 713-C; and titanium alloy A-110AT-ELI. Data were obtained for ultimate and yield tensile strength, elongation, reduction of area, hardness, and notched tensile and shear strength properties. Summaries of these data are presented in tables. Data acquisition systems performed satisfactorily including remotely-operated extensometers. (auth)

3092 THE INFLUENCE OF HEAT TREATMENT, NEUTRON IRRADIATION, AND DEFORMATION ON THE MARTENSITIC TRANSFORMATIONS IN METASTABLE β_1-BRASS. Koger, John Wayne. Gainesville, Fla. Univ. of Florida, 1967. 163p.

Thesis.

The martensitic transformations in metastable β_1-Cu-Zn (with 38.3 to 39.4 wt percent zinc) were studied to determine the effect of repeated thermal cycling, deformation, annealing, bombardment with fast neutrons, and the presence of untransformable phases on these transformations. To monitor the transformations electric resistance was measured and complemented by optical and electron microscopy and x-ray diffraction analysis. The principal characteristics of the transformation on cooling, determined from the resistance measurements, were found to be the M_s-temperature, the temperature coefficient of electrical resistivity of the phases, the area of the hysteresis loop of the (percent) transformation curve, and the rate of transformation. The M_s-temperature changes according to the treatment given the sample. Elastic deformation and the presence of retained martensite would raise the M_s. The M_s-temperature was lowered after plastic deformation and neutron irradiation but was not affected by heat treatments up to 135°C. Retained martensite formed during the first thermal cycle was found to be present at room temperature in samples which had an M_s-temperature above –33°C. The amount of retained martensite increased with increasing M_s-temperature. The shift of M_s between two cycles is a linear function of retained martensite. The retained martensite was observed to grow above the previously found M_s-temperature. Untransformable phases, such as α and deformation-martensite, acted as obstacles to the formation of low-temperature martensite. As the amount of these phases increased, the area of the hysteresis loop of the transformation curve increased; the maximum rate of transformation decreased; and the temperature range of transformation was spread over a wider range, thus increasing the amount of energy needed to complete the transformation. In samples which were irradiated with fast neutrons no such increase in the area of the hysteresis loop was detected, showing that the irradiation induced defects are only small disturbances. Using cold-stage electron microscopy it was observed that martensite formed immediately after a heavy bending movement of the foils. Differences in the growth mechanism during cooling and heating were found. (Diss. Abstr.)

3093 IMPROVED RESISTANCE TO RADIATION DAMAGE IN INCOLOY 800. Harman, D. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 500-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3094 ANOMALOUS BEHAVIOR OF BUBBLES IN AISI TYPE-304 STAINLESS STEEL IRRADIATED IN THE ETR. Brager, H. R.; Robbins, R. E.; Kulcinski, G. L. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 502-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3095 DENSITY CHANGES IN SEVERAL AUSTENITIC STAINLESS STEELS AFTER IRRADIATION IN EBR-II. Lauritzen, T. (General Electric Co., Sunnyvale, Calif.); Ferguson, G.◎Seacrist, L.; Comprelli, F. Trans. Amer. Nucl. Soc., 11: 479-80(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3096 THE EFFECTS OF HIGH FAST FLUENCES ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF TYPE-304 STAINLESS STEEL. Harkness, S. D.; Carlander, R.; Yaggee, F. L. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 480-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3097 INVESTIGATION OF THE INFLUENCE OF COLD-WORKING AND THERMOMECHANICAL TREATMENT ON THE RADIATION-INDUCED, HIGH-TEMPERATURE EMBRITTLEMENT OF AUSTENITIC STEELS. Boehm, Horst; Hauck, Hansjuergen (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 482(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3098 POSTIRRADIATION TENSILE PROPERTIES OF ANNEALED AND COLD-WORKED 348 STAINLESS STEEL. Lovell, A. J. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 482-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3099 TECHNIQUE FOR MEASUREMENT OF CIRCUMFERENTIAL DUCTILITY OF IRRADIATED TUBING. Busboom, H.; Kimball, W.; Withop, A.; Comprelli, F. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc., 11: 483-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3100 TENSILE PROPERTIES OF 25 PERCENT COLD-WORKED AND ANNEALED AUSTENITIC STAINLESS STEELS AFTER FAST REACTOR IRRADIATION. Holmes, James J. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 484-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3101 DEVELOPMENT OF HASTELLOY-N WITH IMPROVED RESISTANCE TO IRRADIATION DAMAGE. Sessions, C. E.; McCoy, H. E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 621(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3102 STUDIES OF INTERACTION OF IMPURITIES PRODUCED BY IRRADIATION. Vigier, P.; Moser, P. (CEN, Grenoble, France). Mem. Sci. Rev. Met., 65: Spec. No., 189-98 (June 15, 1968). (In French).

From International Symposium on the New Physical, Mechanical and Chemical Properties of High Purity Iron, Paris, France. See CONF-660965.

Magnetic after-effect, internal friction, and resistivity measurements of neutron or electron irradiated high purity iron were found different from those of iron specimens containing some impurities (<0.1 wt %). High purity iron shows after irradiation a rather simple system of magnetic after effect zones. The presence of impurities complicates this system which reveals a process of interstitial or vacancy agglomeration around impurity atoms. (tr-auth)

3103 DEFECTS PRODUCED IN IRON BY IRRADIATION. Dautreppe, D. (CEN, Grenoble, France). Mem. Sci. Rev. Met., 65: Spec. No., 175-88(June 15, 1968). (In French).

From International Symposium on the New Physical, Mechanical and Chemical Properties of High Purity Iron, Paris, France. See CONF-660965.

The structure of the damage created in iron is very different in the case of neutron and electron irradiation. Neutron irradiation produces zones of high concentration of faults with agglomerates, and in electron irradiation a very homogeneous distribution of lacunae and interstitials is produced. The stable configuration of faults is shown graphically. The magnetic coupling hysteresis of electron and neutron irradiated iron was measured during an isochronous thermal treatment, and the results are tabulated and graphed. A model is proposed to interpret the experimental results and the four restoration zones observed. (J.S.R.)

3104 DEVELOPMENT OF A BARRIER-LAYER ANODIC COATING FOR REFLECTIVE ALUMINUM IN SPACE. Clarke, D. R.; Gillette, R. B.; Beck, T. R. (Boeing Co., Seattle). Progr. Astronaut. Aeronaut., 20: 315-28(1967).

Results of a research program to evaluate the thermal properties and environmental stability of barrier-layer anodized Al surfaces are presented. Studies showed that the emittance of the barrier-layer anodic coatings could be increased over previously achievable values by modifying the anodizing bath. Emittance values as high as 0.50 were obtained, thus suggesting the use of this coating as a spacecraft thermal control coating. It was also found that the emittance of the coating could be varied from 0.04 to 0.50 by changing the anodization voltage. Terrestrial tests including salt spray, humidity, rain–sunshine cycling, and abrasion were performed. Space environment tests included exposure to uv, proton, alpha particle, and gamma radiation. The experiments showed that the barrier-layer anodic coatings were more stable than other types of anodic coatings. (auth)

3105 SMALL-ANGLE SCATTERING BY RADIATION-INDUCED PRECIPITATIONS IN Pb–Ni ALLOYS. Wohofsky, O.; Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Z. Angew. Phys., 25: 372-9(Nov.-Dec. 1968). (In German).

Precipitation processes are determined by small angle scattering of x rays and partially of neutrons in Pb–Ni alloys. Measurements are made in supersaturated and saturated samples of Pb with 0.1 to 0.5 wt% Ni before and after irradiation with fast neutrons. In supersaturated alloys, fast neutrons create Ni rich precipitations of 20 Å in diameter. In saturated foils, this effect is absent. In all samples alloyed with more than 0.2 wt. % Ni, in which Ni-rich zones exist before irradiation, precipitations are reduced in size. These effects can be explained only under the assumption that large disturbed zones are formed under irradiation. (auth)

3106 STAGE III ANNEALING IN GOLD AFTER ELECTRON IRRADIATION. Lee, Choochon. Urbana, Ill., Univ. of Illinois, 1968. 194p.

Thesis.

Gold specimens of nominal 99.9999% purity were irradiated with 3-MeV electrons near liquid nitrogen temperature. The damage production rate is found to depend on the purity of the specimen giving a lower value for the high purity specimens. It is also found that the production rate is reduced remarkably by quenching the specimen before irradiation. For high purity gold, a single large annealing peak is observed in Stage III. The slope change method and Primak analysis are employed to obtain the activation energy of Stage III annealing. Both methods give 0.85 ± 0.02 eV for the activation energy in high purity irradiated specimens. The activation energies for quenched, and quench-plus-irradiated specimens of comparable purity are found to be 0.85 ± 0.03 eV and 0.86 ± 0.02 eV respectively, agreeing with the value for the irradiated specimens within the experimental error. Somewhat lower values are obtained for specimens of lower purity. Second-order kinetics are obeyed in the main part of the Stage III annealing for the irradiated, quench-plus-irradiated, and quenched specimens. Various models are discussed to explain Stage III annealing. It is concluded that vacancy migration in Stage III with interstitial clusters acting as sinks can account for the observed results most satisfactorily in the case of gold. (Disser. Abstr.)

Ceramics and Cermets

Refer also to abstracts 3013–3015.

3107 I PROCESSI SOL–GEL PER LA PRODUZIONE DI COMBUSTIBILI CERAMICI. SIMPOSIO NUCLEARE DI TORINO, 2–3 OTTOBRE 1967. (Symposium on the Sol–Gel Process for the Production of High-Temperature Ceramics, Turin, Italy, October 2–3, 1967). Rome, Comitato Nazionale Energia Nucleare, 1968. 440p. (In Italian and English). (CONF-671008).

A total of fifteen papers was presented at the conference. A separate abstract was prepared for each of ten papers. The remaining papers were previously abstracted in NSA as 22: 14479, 22: 12476, 21: 44853, 21: 43652, and 21: 2290. (P.G.C.)

For abstracts of individual papers see: 3123–3128, 3130, 3131, 3152, and 3155.

Preparation and Fabrication

Refer also to abstracts 2493, 2526, 2528, 3031, 3038, 3040, 3140, and 3156.

3108 (BMI-X-10242) THE DEVELOPMENT OF BeO–ThO_2–PuO_2 FUELS. Farkas, M. S.; Cheney, D.; Brockway, C. M.; Storhok, V. W. (Battelle Memorial Inst., Columbus, Ohio). Sept. 27, 1968. Contract W-7405-eng-92. 28p. Dep. CFSTI.

Studies indicated that the solid solubilities of ThO_2, PuO_2, and $(Th_{0.8}Pu_{0.2})_{02}$ in BeO are less than 0.05 mole % at temperatures below 1700°C. The minimum solidus temperature in the BeO–ThO_2–PuO_2 system is 2150°C and occurs at the BeO–PuO_2 eutectic. $(Th,Pu)O_2$ solid solutions were chemically stable in wet helium, CO_2, and air atmospheres at 1600°C. In hydrogen, however, the solid solution decomposed to $(Th,Pu)O_{2-x}$ and Pu_2O_3. A particle decrepitation that occurred in all atmospheres was attributed to strains produced by gas pressures generated by the thermal decomposition of hydrocarbons entrapped in the particles during the Sol-Gel preparation process. Techniques for fabricating fuel oxide dispersions in high-density, fine-grained BeO matrices were developed. Voids around the individual fuel particles to accommodate swelling were incorporated through use of a burnout layer. (auth)

3109 (JPRS-45912) RESEARCH ON TREATMENT OF METALS. Translated from Izv. Akad. Nauk SSSR, Metal., No. 3, 88-93; 106-8; 118-20(May–June 1968). 20p. CFSTI.

Three papers are included on the reduction of tantalum pentachloride by hydrogen, rolling metals under vacuum, and electrolytic refining of zirconium carbide. The first two papers are not in scope of NSA. An abstract of the last paper was previously included in NSA from the original language. (See 22: 38609.)(R.C.K.)

3110 (NIJS-R-526) DEPENDENCE OF THE DENSITY ON PARAMETERS OF COMPRESSION PROCESS. Vdovic, J. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). Feb. 1968. 60p. (In German). Dep.

The dependence of the sinter density on the compacting process parameters (pressure, temperature, time) was studied. The problem and the previous studies were critically described. For solution of the problem a method different from the commercial processes was proposed. With consideration of qualitative properties, which the solution must possess, classes of functions with free constants were derived. These constants were adapted to the research results. The compacting density both in discharge and in repeated charge was treated. The agreement with the research results is satisfactory within the limits of measurement accuracy. It was shown that the results can be represented by several functions of about equal simple form. It was also shown that many equations reported in the literature fail to work with the research results. (tr-auth)

3111 BRAZING ALLOY FOR JOINING GRAPHITE TO GRAPHITE AND TO REFRACTORY METALS. (to United States Atomic Energy Commission). British Patent 1,133,309. Nov. 13, 1968. Priority date Sept. 29, 1966, United States.

A brazing alloy consisting of chromium-nickel-palladium is described for use in joinirg graphite to graphite and graphite to refractory metals such as Mo, W, and their alloys. Joining graphite to refractory metals consists of disposing a graphite surface in an overlapping relationship with the refractory metal, placing the brazing alloy between the metal and graphite and heating to at least 1250°C under nonoxidizing conditions. (F.S.)

3112 VIBRATION COMPACTED UO_2 FUEL. I. EFFECTS OF SINUSOIDAL VIBRATION ON COMPACTED DENSITY. Hirose, Yasuo; Takeda, Seiji (Hitachi, Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 5: 529-37(Oct. 1968).

A systematic study has been made on the effect of differences in conditions of applied vibration on the density obtained with a ternary grained powder of arc-fused and crushed UO_2 powder packed in a stainless steel cladding tube. Comprehensive analysis is made of the relation between densities obtained and vibration conditions, defined by combinations of two factors among four-i.e., frequency, displacement, velocity and acceleration. The highest density has been found to be obtained at the highest acceleration, provided that displacement is in the range of 10 to 30 μm, and this range is found to be the optimum condition for all levels of acceleration. The process of vibratory compaction is discussed on the basis of the combination of different factors conducive to the compaction, segregation and disintegration of the powder particles. (auth)

3113 IMPROVEMENTS IN SINTERED NUCLEAR FUELS, IN PARTICULAR CONSISTING OF URANIUM DIOXIDE. Braun, Camille; Delmas, Roger; Francois, Bernard (to Commissariat a l'Energie Atomique). British Patent 1,133,002. Nov. 6, 1968. Priority date Feb. 22, 1965, France.

An improved method is described for sintering nuclear fuels such as UO_2 so that the fuel has an intergranular structure with cavities or pores of closed porosity between the grains but no pores within the grains. The method consists of preforming a powder of predetermined fineness into elements under pressure and heating under an increasing temperature to produce the sintered product. (F.S.)

3114 METHOD OF PREPARING SHAPED CARBON OR CARBON-CONTAINING ARTICLES AND ARTICLES PREPARED BY SUCH METHOD. (to FMC Corp.). British Patent 1,132,782. Nov. 6, 1968. Priority date Feb. 26, 1965, United States.

A method of preparing various shaped articles of pure carbon or pure carbon mixed with other materials consists of heating the shaped article, containing at least 5% by weight cellulose crystallite aggregates, in the absence of oxygen, to a temperature sufficient to carbonize the cellulose. (F.S.)

3115 JOINING GRAPHITE TO GRAPHITE WITH TRANSITION METAL FOILS. Sandstrom, Donald J. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 525 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3116 SINTERING STUDIES ON UN AND $(U_{0.8}Pu_{0.2})N$. Goodyear, M. U.; Smith, R. A.; Kizer, D. E. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 521(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3117 A REPRODUCIBLE PROCESS FOR THE PREPARATION OF LOW- AND HIGH-DENSITY, SINGLE-PHASE, URANIUM–PLUTONIUM CARBIDE PELLETS. Andersen, James C.;

Montgomery, Michael H. (United Nuclear Corp., Pawling, N. Y.). Trans. Amer. Nucl. Soc., 11: 521-2 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3118 THERMODYNAMICS AND MASS TRANSPORT IN THE PLUTONIUM–URANIUM–NITROGEN SYSTEMS. Alexander, C. A.; Ogden, J. S.; Pardue, W. M. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 522 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3119 GAS IMPREGNATION OF GRAPHITE WITH CARBON. Beatty, R. L.; Kiplinger, D. V. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 622-3 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3120 BRAZING OF GRAPHITE FOR MOLTEN-SALT APPLICATIONS. Werner, W. J.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 623 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3121 UO_2 FUEL FABRICATION DEVELOPMENT. Ferrari, Sergio; Giaquinto, Lorenzo; Moretti, Stefano (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 486-7 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3122 ON THE SYSTEM NIOBIUM–HYDROGEN AND TANTALUM–HYDROGEN. Amato, Ignazio; Negro, Alfredo. Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur., 102: 625-36 (1967-68). (In Italian).

Metallic powders of Nb and Ta with granulometry about 5 μ were hydrided at 1000°C for 3 hours. The hydrides obtained have the formulas $NbH_{0.9}$ and $TaH_{0.8}$. The hydrides were then exposed to dehydridation under vacuum at 10^{-4} torr in the temperature interval from 200 to 500°C for durations between 30 min and 5 hrs. The phases obtained during the dehydridation were identified by x-ray analysis. The temperature and the time necessary for complete recovery of the metal were determined. (tr-auth)

3123 PHYSICO-CHEMICAL CONSIDERATIONS ON SOL–GEL PROCESSES. Scibona, G.; Bazzan, A.; Cabrini, A.; Chiarizia, R.; Danesi, P. R.; Magini, M.; Mezi, E. (CNEN–CSN, Casaccia, Italy). pp 25-53 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

The basic problems in refabrication of nuclear fuels by the sol-gel process are reviewed and discussed from the viewpoint of physical chemistry. It is concluded that grain size and porosity are the two most important variables controlling plastic deformation, viscous flow, elasticity, mechanical strength, thermal stresses, electric conductivity, dielectric and magnetic properties of ceramic materials. More quantitative data are needed in the areas of kinetic rate constants for particle size control of gels. Other areas that require investigation include drying and firing of gels with particle sizes in the range of 20 to 200 Å, and mechanisms of crack and pore formation. A flow-sheet for the process is shown. Sixteen references. (P.G.C.)

3124 PRECIPITATION AND HYDROLYSIS OF THORIUM AND URANIUM SALTS: A SURVEY ON RECENT INVESTIGATIONS CARRIED OUT IN THE RUDER BOSKOVIC INSTITUTE. Branica, M.; Bilinski, H.; Tomazic, B.; Sipos, L. (Inst. Ruder Boskovic, Zagreb). pp 105-24 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

Equipment and procedures used in the electrochemical method for reduction and precipitation of oxides of U and Th are described. Methods used to determine physical properties and chemical composition of the precipitates are discussed as are the kinetics of electrolysis. (P.G.C.)

3125 EFFECTS OF CHLORIDE IONS AND U(VI) IONS IN THE SOL–GEL PROCESS OF UO_2. Murase, T.; Muto, T.; Tsuboya, T.; Yokozawa, N. (Atomic Fuel Corp., Tokyo). pp 77-95 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

A flow sheet for the production of dense UO_2 aggregates from UCl_4 solutions by the sol-gel process is presented. Kinetics of crystal growth of UO_2 during aging and drying are discussed and illustrated graphically. It is concluded that the highly active character of UO_2 prepared by the sol-gel process using UCl_4 solutions as the starting material is due not only to the small size of crystallites or the high specific surface, but also to the chloride ions included in the UO_2 lattice. (P.G.C.)

3126 PILOT PLANT DEVELOPMENT, FUEL FABRICATION, AND IRRADIATION TESTS AT CNEN. Cogliati, G.; Giaquinto, L.; Mezi, E. (CNEN, Casaccia, Italy). pp 369-77 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

Pilot plant equipment and techniques developed to produce UO_2 and UO_2– PuO_2 fuels for the C. N. E. N. Fast Reactor are illustrated and discussed. (P.G.C.)

3127 FORMATION OF COLLOIDAL SOLUTIONS OF PU(IV) AND ITS CONVERSION INTO PuO_2 MICROSPHERES. Louwrier, K. P.; Steemers, T.; Zamorani, E. (EURATOM, Karlsruhe, Ger.). pp 269-76 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

Processes developed at Karlsruhe to prepare colloidal solutions of PuO_2 for production of microspheres are discussed. (P.G.C.)

3128 SOL–GEL PROCESSES FOR THE PRODUCTION OF CERAMIC FUELS AT CNEN LABORATORIES. Cogliati, G.; Collenza, F.; Lanz, R.; Lupparelli, V.; Maltzeff, P.; Mezi, E.; Recrosio, A. (CNEN, Casaccia, Italy). pp 239-68 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

The chemical processes involved in the production of spherical microparticles of thoria, urania, mixed thoria-urania, urania-plutonia, and thoria-plutonia for reactor fuels are discussed. Flow sheets for production of four of the ceramic fuels by the sol-gel process are shown. (P.G.C.)

3129 METHOD OF MAKING SINTERED NUCLEAR FUEL PELLETS, IN PARTICULAR CONSISTING OF URANIUM DIOXIDE. Braun, Camille; Delmas, Roger; Francois, Bernard (to Commissariat a l'Energie Atomique). U. S. Patent 3,404,201. Oct. 1, 1968. Priority date Feb. 22, 1965, France.

By close control of powder grain size, compacting pressure, and rate of sintering pellets for nuclear fuels are produced which have an intergranular microstructure characterized by high and closed porosity which ensures thermal stability under thermal interchanges and nuclear radiation. The method is particularly adapted to pellets of UO_2 but may be applied to other fissionable ceramic materials. (P.G.C.)

3130 URANIA AGGREGATE AND SPHERES BY A SOL–GEL ROUTE. Lane, E. S.; Fletcher, J. M.; Fox, A. C.; Holdoway, M. J.; Hyde, K. R.; Lyon, C. E.; Woodhead, J. L. (Atomic Energy Research Establishment, Harwell, Eng.). pp 227-37 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

The catalytic hydrogenation of uranyl nitrate solutions under pressure and at atmospheric pressure was studied. At atmospheric pressure conversion to U(IV) was rapid and complete without losses due to precipitation of basic U(IV). Aggregates and spheres with good physical properties may be produced from the same sol and the process is adapted to use of enriched uranium. A flow sheet for the process is shown as are conditions for reduction. (P.G.C.)

3131 SOL–GEL DEVELOPMENT AT KEMA. Kanij, J. B. W.; Noothout, A. J.; van der Plas, Th.; Hermans, M. E. H. (Keuring van Electrotechnische Materialen, N. V., Arnhem, Netherlands). pp 139-60 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

A review is presented of development of the sol-gel nuclear fuel process at KEMA which is oriented towards materials consisting of ThO_2 with 1.5 to 15% UO_2. Includes methods for preparing sols and for the formation of dispersions and discusses the gelation processes, washing, drying, and sintering of the gelled spheres. (P.G.C.)

3132 IMPROVED THORIUM OXIDE MATERIAL. (to United States Atomic Energy Commission). British Patent

1,132,129. Oct. 30, 1968. Priority date Oct. 19, 1965, United States.

An invention relating to preparation of ThO_2 and ThO_2-UO_2 materials having improved dissolution properties is described. The preferred preparation method is the sol-gel process. The process yields millimeter size oxide particles having densities in excess of 98% of theoretical and which are suitable for fabrication into high-density heterogeneous fuels. (F.S.)

3133 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF ARTICLES OF A POROUS OR CELLULAR NATURE. Horsley, Geoffrey Winton; Podo, Luigi Attilio (to United Kingdom Atomic Energy Authority). British Patent 1,131,425. Oct. 23, 1968. Filed Mar. 25, 1965.

A process for the production of a porous nuclear fuel particles is described. Grains of substances such as urania/thoria or thoria and a non-metallic substance like carbon which is oxidizable below the melting point of the metallic or refractory are heated to a sintering temperature in an atmosphere which inhibits chemical reaction. The sintered particle is then heated in an atmosphere which oxidizes and removes the nonmetallic substances but maintains the chemical and physical state of the refractory or metallic substance produced in the first sintering. Carbon monoxide is suggested for the first and oxygen is used as the second atmosphere. (F.S.)

3134 SYNTHESIS OF GLASS IN THE SYSTEM P_2O_5–ZnO–UO_3. Wilk, H. P. Szklo Ceram., 19: No. 3, 76(1968). (In Polish).

In this system relatively stable glasses have been found. They can be used for the production of nuclear-fuel elements. (Brit. Ceram. Abstr.)

Properties Evaluations

Refer also to abstracts 2513 and 3597.

3135 (BMwF-FBK-68-24) INVESTIGATION OF MECHANICAL PROPERTIES OF CERAMIC AND CERMET REACTOR MATERIALS. Claussen, N. (Max-Planck-Institut fuer Metallforschung, Stuttgart (West Germany). Institut fuer Sondermetalle). June 1968. 43p. (In German). Dep.

The diametral-compression test can successfully be applied to ceramics and cermets. By means of this test, the theoretical basis of which is explained in detail, not only indirect tensile strength, but also Young's modulus and Poisson's ratio of some uranium compounds (UO_2, UN, UO_2–UN-mixtures), dispersions (UO_2–MgO, UO_2–Al_2O_3) and cermets (UO_2–Mo, UO_2–W, UN–Mo, UN–W) have been determined. Some theoretical and empirical strength-concentration relations are discussed. (auth)

3136 (GAMD-8689) EVALUATION OF GLCC GRADE H-327 GRPHITE LOGS. Meyers, C. (Gulf General Atomic, Inc., San Diego, Calif.). June 21, 1968. Contract AT(04-3)-633. 368p. Dep. CFSTI.

A series of tests has been performed to evaluate five logs from pilot-lot 340 of GLCC grade H-327 graphite with regard to mechanical and thermal/physical properties. The mechanical properties examined included ultimate compressive strength (UCS), ultimate tensile strength (UTS), strain-to-fracture (ϵ_F), tensile modulus of elasticity (E_T), and tensile secant modulus of elasticity (E_S). The UCS mean parallel to log axis (PL) values ranged from 3678 psi (log 4) to 4698 psi (log 3), and the mean perpendicular to log axis (PR) values ranged from 3433 psi (log 4) to 4214 psi (log 3). The five-log conglomerate UTS mean PL values (Type III configuration) showed a gradient in the log-radial direction: near centerline (NRCL) ... 1173 psi, near mid-radius (NRMR) ... 1351 psi, and near edge (NREG) ... 2218 psi. A similar set of conglomerate PR mean values revealed nearly equal NRCL and NREG values, with a dip at NRMR: NRCL ... 1000 psi, NRMR ... 773 psi, and NREG ... 961 psi. No significant influence on results for Type III samples was found for those samples that broke within one diameter from the end attachment. A fourfold increase in testing rate produced a drop of ~12% in UTS of Type III samples. Four types of tensile-sample configurations were tested; comparative results revealed that the configuration presently preferred by GGA (Type III, glued-end cylinders) was superior to or as good as two of the other configurations for room-temperature testing. However, the test performance of the configuration presently preferred by GLCC (Type II, pin-ended dog-bone shape with square cross section) was superior to that of the Type III configuration; i.e., Type II UTS values were ~8% higher than Type III values, and data scatter with Type II samples was reduced as well. Based on the presently specified method of sampling logs for UTS, logs 3, 4, and 8 could have been acceptable. Logs 6 and 7 were sampled only at mid-radial locations, but these also could have been acceptable. (Note that the above utilizes mean values for such an assessment and that the indicated data scatter could affect the individual evaluation of each log to the extent that it might not be acceptable.) Re-sampling (if necessary for acceptance) by taking a tensile bar from the center hole of a fuel block will yield a lower average UTS than the original UTS average between outer-slab and control-rod-hole samples. Thus, it is not likely that any log that exhibits an initial UTS average less than 1500 psi will be acceptable upon retesting, unless the initial test procedure was faulty. The thermal/physical properties examined were thermal expansion (CTE), thermal conductivity (k), and density (ρ). Values of ρ ranged from 1.772 to 1.845 g/cm^3, with a fairly uniform distribution axially. However, a significant radial gradient in ρ was observed; this gradient decreased from NRCL to NREG locations. Such unexpected behavior was attributed to very high iron levels within the central portions of the logs. The PL values for CTE ranged from 1.80×10^{-6} to 2.16×10^{-6}/°C, with fair uniformity throughout the logs. The PR values for CTE ranged from 3.71×10^{-6} to 4.84×10^{-6}/°C, with a small gradient in CTE, which decreased from NRCL to NREG locations. Values of k were measured between room temperature and about 800°C. The PL values for k ranged between 0.49 and 0.66 cal/cm-sec-°C at room temperature, and between 0.19 and 0.26 cal/cm-sec-°C at 800°C. The PR values for k ranged between 0.35 and 0.38 cal/cm-sec-°C at room temperature, and between 0.11 and 0.17 cal/cm-sec-°C at about 800°C. (auth)

3137 (GAMD-8737) EVALUATION OF UCC GRADE TS-814 (AGOT-NP) GRAPHITE LOG. Meyers, C. (Gulf General Atomic, Inc., San Diego, Calif.). July 9, 1968. Contract AT(04-3)-633. 34p. Dep. CFSTI.

A mid-length slab from one 17-inch-diameter log of UCC grade TS-814 graphite was sampled, and measurements were performed on mechanical and thermal/physical properties. Tensile tests yielded results for ultimate tensile strength (UTS), strain-to-fracture (ϵ_F), tensile modulus of elasticity (E_T), and tensile secant modulus of elasticity (E_S) at near edge (NREG), near mid-radius (NRMR), and near centerline (NRCL) radial locations within this slab. The mean UTS values for two groups of parallel to log axis (PL) samples were ~1782 psi and ~1524 psi at the NREG and the NRMR locations, respectively. The mean UTS value for a group of perpendicular to log axis (PR) samples was ~756 psi at the NRMR location. Thermal expansion tests were conducted on two groups of PR samples and on one PL sample, with the following average results: PR/NREG ... 4.49×10^{-6}°C^{-1}, PR/NRCL ... 3.85×10^{-6}°C^{-1}, and PL/NRCL ... 2.03×10^{-6}°C^{-1}. Thermal conductivities of these same sample groups were measured and found to range between ~0.30 (at room temperature) to ~0.10 (at 800°C) for the two PR groups, and between ~0.50 (at room temperature) and ~0.23 (at 800°C) for the single PL sample. Bulk density data ranged from an average of 1.763 (at NRCL location) to 1.808 g/cm^3 (at NREG location). The mechanical and thermal/physical properties (as well as impurity levels) were within limits specified by GGA for Fort St. Vrain Reactor fuel element graphite. (auth)

3138 (GAMD-8738) EMPIRICAL CORRELATIONS OF PROPERTIES OF GRAPHITES. Meyers, C. (Gulf General Atomic, Inc., San Diego, Calif.). July 9, 1968. Contract AT(04-3)-633. 36p. Dep. CFSTI.

Property data on grades of graphites studied for applications in Fort Saint Vrain Reactor have been examined for parametric correlations. Those in which such relationships were found are reported for use as a guide to assist design groups in making engineering estimates of the properties of graphites in general. (auth)

3139 (JUL-526-RE) CALCULATION OF THE INTERMITTENT MICROSCOPIC TEMPERATURE DISTRIBUTION IN MATRIX FUEL ELEMENTS BY MEANS OF AN IMPLIED DIFFERENCE METHOD. Biedermann, Dieter (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren). May 1968. 101p. (In German). Dep.

Thesis. Submitted to Technische Hochschule, Aachen, Ger.

The unstationary microscopic temperature distribution in matrix fuel elements was determined. A digital program was used to solve the unstationary heat conduction equation by means of an implicit difference method. For the weight factors contained in the calculation method, optimum values were obtained with reference to the stability behavior and the calculation accuracy. The digital program, which is applicable to the calculation of one-dimensional, unstationary and stationary heat conduction processes with temperature-dependent material value in cartesian, cylindrical, and spherical coordinates, was described and the data presentation was explained. The program was applied to calculation of the microscopic temperature distribution in matrix fuel elements. Graphite and beryllium oxide were studied as matrices and uranium carbide and uranium dioxide as fuel materials. (tr-auth)

3140 (LA-3989) CMF-13 RESEARCH ON CARBON AND GRAPHITE. Report No. 6. Summary of Progress, May 1–July 31, 1968. Smith, Morton C. (Los Alamos Scientific Lab., N. Mex.). Sept. 4, 1968. Contract W-7405-eng-36. 33p. Dep. CFSTI.

Results of research and development on the properties and behavior of C and graphite for use as nuclear engineering materials are reported. Information is included on raw material processing and fabrication techniques, evaluations of the properties of binders and fillers, mixing processes, and heat treatments. Extrusion parameters are shown graphically and results of microstructural studies and measurements of physical and mechanical properties are tabulated. (P.G.C.)

3141 (LA-DC-9969) THERMAL DIFFUSIVITY OF SX-5 GRAPHITE FROM 800° TO 2800°C. Morrison, B. H. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 19p. (CONF-681009-9). Dep. CFSTI.

From 8th Annual Conference of Thermal Conductivity, Lafayette, Ind.

The thermal diffusivity of SX-5 graphite in orthogonal axes was measured at 800 to 2800°C by the laser flash technique in a vacuum and in a helium atmosphere. A neodymium glass laser system was the pulsed energy source; a photomultiplier tube was used to detect the transient-time temperature response of the thin samples. Cowan's method for correction of the heat loss and a finite pulse time correction were included in the thermal diffusivity calculations. The thermal diffusivity data were fitted to a function in reciprocal temperature by a least squares technique. The precision of the flash technique was certified by repeated measurements on many samples. The accuracy of the measurements was estimated by comparison with published high temperature thermal conductivity data on other graphites and on Armco iron. (auth)

3142 (N-68-27399) PROPERTIES OF TANTALUM CARBIDE–GRAPHITE AND NIOBIUM CARBIDE–GRAPHITE COMPOSITES. Harada, Y.; Bortz, S. A. (IIT Research Inst., Chicago, Ill.). [1967]. Contract NASr-65(09)-003-909. 27p. (NASA-CR-85164). CFSTI.

Tantalum carbide–graphite and niobium carbide–graphite composites were prepared by hot-pressing at 3000 to 3200°C. The effect of metal carbide content upon properties such as flexural strength, thermal expansion, compressive deformation, and electrical resistivity were determined, both parallel and perpendicular to grain direction. The results show that with increasing carbide content higher strength, decreasing anisotropy, decreasing resistance to high temperature plastic deformation, and decreasing electrical resistivity are observed. (auth)

3143 (N-68-27531) METAL CARBIDE–GRAPHITE COMPOSITES. Harada, Y. (IIT Research Inst., Chicago, Ill.). Apr. 28, 1968. Contract NASr-65(09). 41p. (NASA-CR-95222; IITRI-G-6003-Q7). CFSTI.

Carbon powders of various sizes, shapes, and processing histories were incorporated into composites of 47 vol % NbC, in order to determine their effects on such properties as strength, thermal expansion, high temperature deformation resistance, and degree of anisotropy. Creep tests conducted at high temperatures show: the best creep resistance in both grain directions is exhibited by composites incorporating M2 graphite, a heat treatment of one hour at 2500°C does not materially change creep behavior of NbC–C composites, and examination of compressive creep behavior at 2700°C, 2000 psi for 30 minutes, reveal changes in length of less than 1% in either grain direction. An evaluation of densification aids for TaC–C composites shows that 5 vol % of Mo, W, or NbC in composites containing about 45 vol % TaC yields dense, well-bonded composites with excellent high temperature properties. The preliminary data indicate that additives of about 50 vol % carbide content exhibit better creep resistance than equivalent TaC–C composites without additives. (STAR)

3144 (WANL-TME-1782) MECHANICAL PROPERTIES OF THE GROUP IVB AND VB TRANSITION METAL MONOCARBIDES. Brizes, Wm. F. (Westinghouse Electric Corp., [Pittsburgh, Pa.] Astronuclear Lab.). Apr. 1968. Subcontract NP-1. 45p. Dep. CFSTI.

The mechanical behavior of the Group IVB and Group VB monocarbides has been studied on one hundred per cent dense samples made by liquid state carburization. The properties investigated were thermal expansion, yield stress, and room temperature hardness as a function of stoichiometry. The activation energy for deformation of niobium carbide was determined from high temperature yield stress data and was found to be 133 kcal/mole, a value that is in good agreement with the activation energy for niobium monocarbide. (auth)

3145 LOW TEMPERATURE SHRINKAGE OF THORIA GEL: PART I. KINETICS. PART II. SHRINKAGE MODEL. Chang, Ru Kao. Salt Lake City, Univ. of Utah, 1968. 144p. Thesis.

The rate of desorption of chemisorbed gases, primarily NO_2, H_2O, and CO_2, from pressed thoria gel pellets was measured by means of isothermal length decrease of the pellets as a function of time at various temperatures in the range 25 to 500°C. A kinetic equation based upon a fundamental model of the relationship between weight change and length change for an isotropic solid and employing an activation free energy dependent upon coverage of the surface by the chemisorbed gases was developed and was obeyed by the experimental results. The variation of activation free energy with surface coverage was found to result from variations of the activation enthalpy rather than the activation entropy. Values of 11.7 kcal/mole with complete surface coverage and 36.3 kcal/mole for zero coverage were measured for the activation enthalpy, while the activation entropy was −19.5 eu. The dependence of desorption rate upon temperature and hence upon coverage was so great that about one-fourth to one-third of the chemisorbed species still remained at T = 500°C. The maximum desorption rate of chemisorbed species was at about 350°C on the basis of these results. Physically adsorbed species, primarily water, were removed up to about 150 to 200°C. Removal of these species did not follow the kinetic desorption equation which was obeyed by the chemisorbed species and was of no kinetic interest in this study. Outgassing above about 150 to 200°C produced a gel which was non-dispersable in water, whereas the gel dispersed readily in water when outgassed below this approximate temperature. Shrinkage data for thoria gels of 0.15 and 0.20 NO_3/ThO_2 mole ratios showed a linear relation between normalized weight loss and shrinkage with almost the same value for the constant relating these two parameters found previously for gels of 0.1 NO_3ThO_2 ratio. Gas chromatographic analysis of the chemisorbed gases desorbed during shrinkage showed CO_2, NO_2, and H_2O decreasing in the order given. During shrinkage the bonding of the 70 Å radius thoria gel particles changes from van der Waals to chemical bonds producing most of the bonding. The HNO_3 group migrates to an exposed surface site to produce NO_2 and possibly H_2O and undergoes weight loss. The possibility of surface hydroxyl as well as surface carbonate groups producing gel particle bonding by other mechanisms is presented. (Diss. Abstr.)

3146 FISSION PRODUCT ESCAPE FROM COATED FUEL PARTICLES AFTER REACTOR IRRADIATION. Riedel, H. J. (Kernforschungsanlage, Juelich, Ger.). Radiochim. Acta, 9: 144-9(Aug. 1968). (In German).

The fuel elements and breeding material used in high temperature gas-cooled reactors are particles coated with pyrocarbon and silicon carbide. The degree of contamination of the cooling system is governed by the hold-back ability (of the coating material) for gaseous and solid uranium fission products as well as by the transport of fission products through the coating material. In connection with the investigation of the property of various types of particles as a function of temperature, burn-up, and geometry of the pile of particles the distribution of the fission products in the graphite layer around the particles was studied radiochemically. Distillation, precipitation, liquid-liquid extraction, and ion exchange techniques were used to separate and analyze the fission elements. These methods are discussed briefly. Twelve radionuclides can be determined this way. A high mobility was observed for the fission elements Ba, Sr, and Y. The release of other fission products with high yields is much less effective. Some parameters influencing the release of fission products are discussed. (auth)

3147 PREPARATION, STRUCTURE, AND PROPERTIES OF SPUTTERED, HIGHLY NITRIDED TANTALUM FILMS. Coyne, H. J. Jr. (Western Electric Research Center, Princeton, N. J.); Tauber, R. N. J. Appl. Phys., 39: 5585-93(Nov. 1968).

Highly nitrided films of tantalum have been prepared by cathodically sputtering high-purity tantalum in a pure nitrogen atmosphere. The effects of cathode current density and film thickness on the film structure, crystal structure, composition, resistivity, current–voltage characteristics, and optical energy gap were investigated. Transmission electron microscopy showed the films to be apparently discontinuous throughout the range of cathode current densities investigated for 1600 Å thick specimens. The crystal structure determined by electron diffraction analysis was found to be body-centered tetragonal with c = 5.01 Å, a = 5.77 Å, and c/a = 0.87. The presence of small amounts of hexagonal TaN was also observed. Analysis of the gas content showed the amount of nitrogen to be a function of cathode current density and thickness. Electrical resistivity as a function of temperature in the range of 213 to 373°K obeyed the relationship $\rho = A \exp(\Delta E/kT)$, where ΔE decreased with the increasing cathode current

density and film thickness. Current–voltage characteristics obtained at 77°K indicated non-Ohmic behavior at large applied voltages. The resistivity could be expressed by log (ρ @ V = 0/ρ) = $AV^{\frac{1}{2}}$ above some critical V, where V critical and A are dependent on both film thickness and cathode current density. This behavior could be attributed to conduction by an "intergrain tunneling" mechanism. The apparent optical energy gap was found to be in the range of 1.95–2.6 eV depending on sputtering current and thickness. (auth)

3148 MASS SPECTROMETRIC STUDY OF THE RHENIUM–OXYGEN SYSTEM. Battles, J. E.; Gundersen, G. E.; Edwards, R. K. (Argonne National Lab., Ill.). J. Phys. Chem., 72: 3963-9 (Nov. 1968).

The vaporization behaviors of the two-phase solid systems Re + ReO_2 and ReO_2 + ReO_3 were investigated by combined mass-loss and mass spectrometric Knudsen effusion studies. The vapor phase in equilibrium with each of the two systems is the same, primarily Re_2O_7(g) with only a minor amount (<5%) of ReO_3(g). The condensed phase(s) were identified before and after vaporization by x-ray diffraction analysis. Mass spectrometric data are combined with the mass-loss effusion data to yield the following equations for the vapor pressure (calculated as Re_2O_7). For the reaction $3ReO_3(s) \rightleftharpoons ReO_2(s) + Re_2O_7(g)$, log P(atm) = 12.529 ± 0.270 – [(11,913 ± 173)/T] (612 to 710°K), with ΔH_T^0 = 54.5 ± 0.8 kcal/mole. For the reaction $\frac{7}{2}ReO_2(s) \rightleftharpoons \frac{3}{2}Re(s) + Re_2O_7(g)$, log P(atm) = 14.442 ± 0.145 – [(20,447 ± 143)/T] (961 to 1087°K), with ΔH_T^0 = 93.5 ± 0.7 kcal/mole. The thermodynamic properties have been recalculated to 298°K by estimating a constant $\Delta C_p \approx -4$ cal/deg mole for the sublimation reactions: $\Delta H_{f298}^0(ReO_2(s))$ = –102.8 ± 2.0 kcal/mole; $S_{298}^0(ReO_2(s))$ = 13.5 ± 1.6 eu; ΔH_{f298}^0 ($ReO_3(s)$) = –140.7 ± 2.0 kcal/mole; and $S_{298}^0(ReO_3(s))$ = 19.3 ± 1.5 eu. In the course of this study, the appearance potential of Re_2O_7(g) was found to be 13.0 ± 0.5 eV. (auth)

3149 VAPORIZATION THERMODYNAMICS OF TRIEUROPIUM TETROXIDE. Haschke, John M.; Eick, Harry A. (Michigan State Univ., East Lansing). J. Phys. Chem., 72: 4235-9 (Nov. 1968).

Trieuropium tetroxide was prepared by reaction of sesquioxide. oxide chloride, and lithium hydride in a tungsten crucible under vacuum. The vaporization of the tetroxide according to the reaction $3Eu_3O_4(s) \rightarrow 4Eu_2O_3$(s, monoclinic) + Eu(g) was studied over the temperature range from 1604 to 2016°K by target collection effusion techniques. The condensed effusate was analyzed by x-ray fluorescence. For the reaction at 1810°K, ΔH_T^0 = 86.2 ± 1.4 kcal/gfw and ΔS_T^0 = 28.20 ± 0.82 eu. Heat capacity data for Eu_3O_4(s) were estimated, and second- and third-law enthalpies for the reaction are presented. For $Eu_3O_4(s)$: ΔH_{f298}^0 = –542.4 ± 3.6 kcal/gfw, ΔG_{f298}^0 = 514.4 ± 3.6 kcal/gfw, and S_{298}^0 = 48.6 ± 2.6 eu. (auth)

3150 DEFORMATION OF UO_2 SINGLE CRYSTALS. Yust, C. S.; McHargue, C. J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 487 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3151 THE RATE OF BUBBLE GROWTH IN SUPERHEATED LIQUID SODIUM. Theofanous, T. (Univ. of Minnesota, Minneapolis); Biasi, L.; Isbin, H. S.; Fauske, H. K. Trans. Amer. Nucl. Soc., 11: 692-3 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3152 ABSORPTION SPECTRA OF URANIUM(IV) HYDROXO COMPLEXES IN WATER SOLUTION. Baran, V.; Tympl, M. (Inst. of Nuclear Research, Rez, Czechoslovakia). pp 125-36 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968.

See CONF-671008.

Solutions of uranium perchlorate with a concentration of 0.8 moles per liter were prepared by electroreduction. Free perchloric acid, in relation to U, was about 1:1; the hexavalent U content was below 1%. The absorption spectra of the hydroxo complex were determined at several concentrations using a double beam spectrophotometer with automatic registration. (P.G.C.)

Structure and Phase Studies

Refer also to abstract 3140.

3153 PHASE EQUILIBRIA AND POINT DEFECT DESCRIPTION IN THE SYSTEMS La_2O_3–ThO_2, Gd_2O_3–ThO_2, Yb_2O_3–ThO_2, AND CaO–ZrO_2. Diness, Arthur Michael. University Park, Pa., Pennsylvania State Univ., 1967. 241p.

Thesis.

Subsolidus phase relations were investigated in three representative rare earth sesquioxide-thoria systems and the system CaO–ZrO_2 to characterize phases of potential interest in solid state reaction kinetics studies. Crystalline solubility characteristics related to the point defect character of these (fluorite-type) materials were determined. Two new crystalline phases were discovered in the La_2O_3–ThO_2 system: $4La_2O_3$: $1ThO_2$ and $2La_2O_3$: $1ThO_2$. These phases exist at conditions approaching equilibrium, and exhibit temperature stability minima. The 4 : 1 compound dissociates below 1000°C into La_2O_3 and ThO_2 crystalline solutions. The 2 : 1 compound dissociates into ThO_2(C.S.) and the 4 : 1 compound. The ThO_2 crystalline solution field extent is approximately 39 mole percent La_2O_3 at 1940°C. Little ThO_2 exists in A-type La_2O_3 crystalline solutions. In the system Gd_2O_3–ThO_2, the fluorite crystalline solution field extends from 19 mole percent Gd_2O_3 at 800°C to 45 mole percent Gd_2O_3 near 2000°C. Hydrothermal conditions caused substantial exsolution of Gd_2O_3 from ThO_2(C.S.) at 800°C. A new finding is the extensive field (greater than 25 mole percent at 1800°C) of the C-type structure solutions. The polymorphic C- to B-type Gd_2O_3 inversion temperature is raised substantially by raising the ThO_2 content. Only 10 mole percent Yb_2O_3 dissolves in ThO_2 at 1800°C. Approximately 3 mole percent ThO_2 is soluble in C–Yb_2O_3 at 1800°C. Good agreement exists between the pure anion vacancy models and the experimentally determined fluorite-field crystalline solution densities in the rare earth oxide–ThO_2 systems. For the C-type crystalline solutions (Yb_2O_3- and La_2O_3–ThO_2) the calculated anion interstitial model agreed with the pycnometric densities. The subsolidus equilibrium relations in the CaO–ZrO_2 system were determined. The pinching-in, and closing off of the cubic ZrO_2(C.S.) field was noted. At 1800°C, this field extended from 10 to 28 mole percent CaO. This field narrowed to zero extent near 800°C, 15 mole percent CaO. Hydrothermal environment allowed equilibrium to be more nearly approached than in previous investigations. The role of the high-pressure, high-temperature water is taken as purely catalytic. Direct evidence of possible proposed point defect models for fluorite structure crystalline solutions in the system CaO–ZrO_2 was sought by means of x-ray intensity, pycnometric, and precision lattice parameter determinations. These studies led to the conclusion that materials in this system exhibit the first reported inversion of majority point defect type as a function of composition and temperature. (Diss. Abstr.)

3154 NEW EXPERIMENTAL AND THEORETICAL APPROACHES TO THE GLASSY STATE. Sarjeant, Peter Thomson. University Park, Pa., Pennsylvania State Univ., 1967. 135p.

Thesis.

Metastable unary and binary oxide phases obtained by rapid quenching techniques have been investigated by infrared spectroscopy, x-ray and the electron probe. The rate of cooling required to form short-range order oxide (SROO) solids has been found to depend directly on the melting temperature and coefficient of self diffusion, and inversely upon melt viscosity, relaxation time and linear dimensions of the ionic species comprising the melt. Calculated dependence of the formation of SROO solid phases as a function of these parameters is shown graphically. The relation of crystal chemical parameters (such as ionic radius, coordination and valence) is shown to be critical in glasses formed by rapid quenching of perovskite and garnet compositions. Single oxides with oxygen ions in close packed array or in coordination three or higher could not be rapidly quenched to glasses. A wider compositional range for metastable crystalline solid solution was found in certain binary systems. The relation between the structure of the melt and these metastable phases is discussed. The following binary systems were investigated in detail: MgO–Al_2O_3, NiO–Al_2O_3, Sc_2O_3–Al_2O_3, and CaO–Bi_2O_3, showing extended crystalline solid solution range; BaO–TiO_2, Y_2O_3–Al_2O_3, Gd_2O_3–Al_2O_3, CaO–Al_2O_3, K_2O–Nb_2O_5, and MgO–SiO_2, showing extensive SROO formation on rapid quenching. Certain organic compounds were also investigated. (Disser. Abstr.)

3155 PREPARATION AND STRUCTURE OF SOLS AND GELS OF METAL OXIDES AND HYDROXIDES. Hardy, C. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 55-76 of I Processi Sol–Gel per la Produzione di Combustibili Ceramici. Simposio Nucleare di Torino, 2–3 Ottobre 1967. Rome, Comitato Nazionale Energia Nucleare, 1968. (AERE-R-5619).

See CONF-671008.

A review of recent and relevant older work is presented on the preparation and structure of sols and gels of metal oxides for nuclear and non-nuclear uses with particular attention to sols and gels of ThO_2, UO_2, and rare earth hydroxides. Merits of the sol-gel process are discussed as are the kinetics of calcination of gels to oxides. Forty-seven references. (P.G.C.)

3156 PHASE EQUILIBRIA IN AN YTTRIA–ALUMINIA–NEODYMIA SYSTEM. Bakradze, R. V.; Kovba, L. M.; Kuznetsova, G. P.; Trunov, V. K. (Moscow State Univ.). Dokl. Akad. Nauk, SSSR, 179: 849-51(1968). (In Russian).

The pseudobinary $3Y_2O_3 \cdot 5Al_2O_3 - Nd_2O_3 \cdot Al_2O_3$, $3Y_2O_3 \cdot 5Al_2O_3 - Nd_2O_3$, and $3Y_2O_3 \cdot 5Al_2O_3 - (3Nd_2O_3 \cdot 5Al_2O_3)$ (a hypothetical compound) of the ternary $Y_2O_3 - Al_2O_3 - Nd_2O_3$ system was studied. The study of phase equilibria in such refractory systems involves great difficulties, therefore, to obtain specimens of different compositions a method of spontaneous crystallization from solution was used in a lead oxide-lead fluoride melt with the addition of boric oxide. A platinum crucible with a mixture of starting materials was placed in a crystallization furnace heated to 1200°C. The melt was kept at this temperature until a homogeneous melt was obtained. The temperature was lowered according to a set program. The crystals were extracted by treating the solidified solvent with dilute nitric acid and slight heating. Neodymium was introduced into the starting mixture as a neodymium oxide and a neodymium oxide with additions of aluminum oxide corresponding to $Nd_2O_3 \cdot Al_2O_3$ and $3Nd_2O_3 \cdot 5Al_2O_3$ stoichiometric composition. The phase composition of the single crystals obtained was established by the optical crystallography method and x-ray analysis while spectral analysis was used for a quantitative determination of neodymium and yttrium. An isothermal slice of $Al_2O_3 - Y_2O_3 - Nd_2O_3$ was constructed on the basis of the data obtained. The maximum concentration of neodymium and yttrium aluminum garnet may be obtained if crystallization is conducted in the $Al_2O_3 - (Y,Nd)3Al_5O_{12}(Y,Nd)Al_2O_3$ three-phase region. The maximum concentration of yttrium in $NdAlO_3$ is obtained during crystallization from the $(Y,Nd)_3Al_5O_{12} - (Y,Nd)AlO_3 - Y_4Al_2O_9$ (or $YAlO_3$) three-phase regions. Two-phase specimens containing cubic or hexagonal peroxides were not found. This can be explained by the absence of a two-phase region or by the fact that it is very narrow. (ATD)

3157 LATTICE STRAIN IN TUNGSTEN CARBIDE. Gillies, D. C.; Lewis, D. (Surrey Univ., Guildford, Eng.). Powder Met., 11: 400-10(1968).

X-ray-diffraction measurements showed that ball-milling of tungsten carbide powder gives rise to considerable line broadening. Analysis of this broadening by integral-breadth and Fourier methods indicated that the main cause of the broadening is lattice microstrains. X-ray studies were made on tungsten carbide powders, sintered blocks, and tool tips with cobalt binding, to determine how this strain varies at different stages of treatment of the material. It was found that, after sintering, the tungsten carbide was strain-free, but diamond polishing and mechanical work induced strain in the surface layers. (auth) (UK)

Radiation Effects

Refer also to abstracts 2735 and 3090.

3158 (GA–8559) IRRADIATION EFFECTS ON HOT PRESSED BERYLLIUM OXIDE MATRIX FUEL BETWEEN 800 AND 1600°C. Meyer, R. A.; Lofftus, F. H.; Weed, R. C. (Gulf General Atomic, Inc., San Diego, Calif.). May 15, 1968. Contract AT(04-3)-167. 106p. Dep. CFSTI.

A hot pressed BeO matrix, 5 vol-% UO_2 dispersion type fuel of ½ in. OD was irradiated in a fast flux exposure to 1.24×10^{21} nvt > 0.18 MeV with an energy density in excess of 125 W/cm and then evaluated for physical integrity, dimensional stability, and fission product retention capability to Xe, Kr, Sr, and Cs. The fuel was hot pressed between 1525 and 1700°C to densities in excess of 99% theoretical density. Additives of C, SiC, and SiO_2 were used to maintain grain size of the BeO between 3 and 5 μ. The irradiations were conducted at 800 to 1600°C to fissions per initial fissile atom (FIFA) values in excess of 30%, with equal amounts of fissions from ^{238}U and ^{239}Pu. Measurements during irradiation showed that the retention for Xe and Kr was between 10^{-6} at 800 and 10^{-5} at 1600°C. Postirradiation analyses showed that the retention of Sr was between 87 and 98%, but for Cs it was 67% at 1400 and 1600°C and ≅100% at 800 and 1100°C. (auth)

3159 (TRG-Report–1681) THE BEHAVIOUR OF FISSION GASES IN IRRADIATED UO_2: A RE-SOLUTION PROCESS. Manley, A. J. (United Kingdom Atomic Energy Authority, Sellafield (England). Reactor Group). July 5, 1968. 27p. Dep. CFSTI. UK 4s. 6d.

The re-solution of gas atoms from bubbles into the irradiated UO_2 matrix is considered as a particle-collision process. A semi-empirical approach is made to the problem of the rate of knock-out. On this basis bubble diameters within grains would not be larger than 40 Å after irradiation times of $\sim 10^8$ sec and ratings of 20 MW/te, which is in agreement with observation. The mean time for which fission gases are trapped in bubbles is independent of the bubble size and for a rating of 20 MW/te is ~30 days. The application of the model to intergranular gas bubbles requires a knowledge of the grain boundary diffusion coefficient. This can be obtained by fitting the model to experimental data for the time-temperature dependence of the onset of optically detectable intergranular porosity. It is then possible to predict the conditions of time and temperature at which the grain-boundary bubbles will touch. For irradiation times of $\sim 10^8$ sec they should do so at ~1150°C. Re-solution will tend to amplify the effect of stress on bubbles by further increasing their radii if the applied stress is tensile, or further decreasing them if compressive. Grain boundary bubbles greater than 0.7 μ dia will be unstable under any tensile stress. (auth) (UK)

3160 RECOVERY OF ELECTRICAL RESISTIVITY BELOW 80°K IN ELECTRON-IRRADIATED PYROLYTIC GRAPHITE. Iwata, T.; Nihira, T.; Matsuo, H. (Japan Atomic Energy Research Inst., Tokyo). Phys. Lett., 28A: 146-7(Nov. 4, 1968).

Pyrolytic graphite specimen was irradiated with 0.80 MeV electrons near 6°K and the annealing below 80°K studied, using the electrical resistivity parallel and perpendicular to the c-axis. (auth)

3161 HIGH-TEMPERATURE DISSOLUTION OF UC PRECIPITATES IN IRRADIATED URANIUM. Kulcinski, G. L.; Leggett, R. D. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 496(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3162 NEUTRON DAMAGE IN SINGLE CRYSTAL ALUMINUM OXIDE. Barber, D. J.; Tighe, N. J. (National Bureau of Standards, Washington, D. C.). J. Amer. Ceram. Soc., 51: 611-17 (Nov. 21, 1968).

Synthetic aluminum oxide crystals were irradiated with fast neutrons to a dose of 1.8×10^{20} nvt and examined by transmission electron microscopy. As-irradiated crystals contained damage on a fine scale, revealed by diffraction contrast, and showed a 28% increase in Knoop diamond hardness compared with unirradiated material. Annealing above 600°C decreased the hardness and caused the small defect clusters to grow, forming dislocation loops on $\{10\bar{1}0\}$ planes with $\frac{1}{3}\langle 10\bar{1}1\rangle$ Burgers vectors. High-temperature annealing caused the loops to interact to give dislocation segments. These tended to align with the $\langle 10\bar{1}0\rangle$ and $\langle 11\bar{2}0\rangle$ directions, and some of them had $\frac{1}{3}\langle 10\bar{1}1\rangle$ Burgers vectors. Grown-in dislocations also began to climb but showed evidence of impurity pinning. Isolated platelike precipitates on $\{10\bar{1}0\}$ planes were observed in samples annealed at high temperatures. Possible effects of the observed damage on physical properties are considered; there is qualitative agreement between predictions and existing data. (auth)

Plastics and Other Materials

Refer also to abstracts 2545, 3090, and 4455.

3163 (NSJ-tr–115) ANNEALING EFFECTS ON THE INTERNAL FRICTION AND THE DYNAMIC MODULUS OF PILE-IRRADIATED GRAPHITE. Saito, Michihiro; Kawamura, Kiyoshi; Tsuzuku, Takuro. Translated from Tanso, 51: 7-10(Nov. 1967). 10p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 8853. (R.C.K.)

3164 RADIATION EFFECTS ON FIBER-OPTIC LIGHT GUIDES. Webster, Jack R. (Giannini Controls Corp., Duarte, Calif.). Opt. Spectra, 2: No. 4, 59-61(July-Aug. 1968).

The gamma radiation effects on the optical characteristics of various types of fiber-optic light guides was performed. Fiber types irradiated included radiation resistant crown glass, lead glass and two plastics. After exposure to each of several increasing irradiation levels (up to and including 1×10^4 roentgens), the optical transmission of each sample was measured. Decreases in optical transmission were observed both as a function of wavelength and fiber composition. The radiation resistant types were affected less than the unprotected glass and practically no effect was found for the plastics. (auth)

3165 WELL ORIENTED GRAPHITE COMPOSITES. Ubbelohde, A. R. (Imperial Coll. of Science and Tech., London). Nature (London), 220: 434-6(Nov. 2, 1968).

Advances in the preparation of well oriented graphite crystals have made possible the evaluation of the large anisotropy ratios in their physical properties, including thermal expansion and conductivity, electrical conductivity, and thermoelectric power. (auth) (UK)

3166 ADHESIVES. Anderson, C. Clement (PPG Industries, Pittsburgh). Ind. Eng. Chem., 60: 80-7(Aug. 1968).

A summary is given of the progress made by chemists in the field of synthetic polymer adhesives during the past year with respect to recent publications and new products which have appeared on the industrial market. Polymers, suitable for high-temperature adhesive applications, particularly in the aerospace industry, have been steadily developed and improved. Polybenzimidazole adhesives are used for bonding titanium, beryllium, and stainless steel (Litvak, 1968). Several new polymers have been recently synthesized that are stable at elevated temperatures (Polniaszek and Schaufelberger, 1968). Various surface treatments have been used to improve the adhesion of different materials to polyethylene. Among these treatments are: chromic acid, chlorine plus light, concentrated sulfuric acid, ozone or nitrous oxide plus UV light, flames, UV or γ radiation, and various other electronic treatments. Typical adhesion promoters or coupling agents are: gamma-aminopropyltriethyoxysilane, gamma-mercaptopropyltrimethoxysilane, and N-beta-(aminoethyl)-gamma-aminopropyltrimethoxysilane. (IAA)

3167 IN SITU MEASUREMENTS OF SPECTRAL REFLECTANCE OF THERMAL CONTROL COATINGS IRRADIATED IN VACUO. Cheever, P. R.; Miles, J. K.; Romanko, John (General Dynamics/Fort Worth, Tex.). Progr. Astronaut. Aeronaut., 20: 281-96(1967).

Data on results of exposure of commercial plastic coatings to proton, neutron, and uv radiation are presented. The apparatus developed to measure spectral reflectance is described. (P.G.C.)

3168 THERMOPHYSICS OF SPACECRAFT AND PLANETARY BODIES. Radiation Properties of Solids and the Electromagnetic Radiation Environment in Space. Heller, Gerhard B. (ed.). Progress in Astronautics and Aeronautics. Volume 20. New York, Academic Press Inc., 1967. 993p.

A total of 47 papers is included in the book. Separate abstracts were prepared for two of these papers. Papers for which no abstracts were prepared are concerned with radiation properties of solids, radiation characteristics of planetary bodies, radiant heat transfer, and heat transfer in space. (P.G.C.)

For abstracts of individual papers see: 3104 and 3167.

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstract 3168.

3169 (LA-4018) ELECTRON SYNCHROTRON RADIATION: A BIBLIOGRAPHY. Furnish, Jean (comp.) (Los Alamos Scientific Lab., N. Mex.). Sept. 17, 1968. Contract W-7405-eng-36. 55p. Dep. CFSTI.

Nuclear Science Abstracts was searched from Volume 1 (1948) through Volume 22 Number 16 (August 31, 1968) for information on electron synchrotron radiation. The references include theory, laboratory experiments and astrophysical data. Each item has been roughly categorized for content as indicated by the following designations: (1) accelerator design and operation — calculations and experiments applicable to accelerator design; (2) astrophysics, solar physics, polarized cosmic radiations, space physics, van Allen belts — calculations and experimental work; (3) atomic physics — autoionization and photoabsorption; (4) experiments on the properties of synchrotron radiation; (5) miscellaneous; (6) plasma physics — calculations and experimental work; (7) reviews; (8) tabulated properties of synchrotron radiation technology of use as a source intensity standard; masers; (9) solid-state physics — photoabsorption, excitons, plasmons, and optical constants; and (10) theory. (auth)

3170 SOLUTIONS OF THE NEWTON–LIOUVILLE EQUATIONS FOR LOCALLY ELLIPSOIDAL DISTRIBUTIONS WITH CONSTANT COEFFICIENTS. Truemper, Manfred (Univ., Hamburg). Z. Astrophys., 69: 168-79(1968). (In German).

All solutions (Φ,F) of the Liouville equation and the Poisson equation for a system of gravitating particles are obtained under the following assumptions: 1. The system can be described by a locally ellipsoidal velocity distribution with constant coefficients. 2. The mean velocity field v^k has non-vanishing expansion $v^k{}_{,k}$. It is shown that as a consequence of Liouville's equation the frequency function belongs to the class of ellipsoidal distributions investigated by Chandrasekhar. The mean velocity turns out to be spatially homogeneous, i.e., the differential motions are spatially constant. Poisson's equation can be solved if and only if the mass density (and, therefore, the anisotropic pressure) is spatially constant. The case where the expansion vanishes is not considered. (auth)

3171 FOUNTAIN MODEL FOR PLASMA ENVELOPES OF COMETS. Wallis, M. K. (Manchester Univ., Eng.). Planet. Space Sci., 16: 1221-48(Oct. 1968).

By regarding a comet as a source of CO molecules, the dynamics of the CO^+ envelopes of major plasma comets were investigated. Electron collisional ionization within the envelopes is the main mechanism for plasma production. By analyzing the flow within it, a thin envelope is shown to be dynamically unstable at enhanced solar-wind velocities, as long as the mean expansion velocity of the CO molecules is greater than 3 km/sec. An unstable envelope always contracts in towards the head; it also acts as the source of a sunward fountain of plasma which initiates a new outermost envelope. The material of each envelope flows into a number of tail rays, and the phenomenon of "closing-in" rays is related to the decreasing pressure within the aging envelopes. The existence of an innermost stationary envelope, from which the main tail rays arise, is predicted. The varied and rapidly changing tail structure is largely due to the inherent instabilities of the ionization and plasma interaction mechanisms. The model is also applicable to smaller comets which neither possess distinct plasma envelopes nor exhibit fountain behavior. (auth) (UK)

Stars

Refer also to abstracts 3269 and 3296.

3172 AUTOCORRELATION AND SPECTRAL ANALYSIS OF THE LIGHT CURVES OF SS CYG, Z CAM, AND RU PEG. Lukatskaya, F. I.; Polishchuk, G. A. (State Astronomical Observatory, Kiev). Astrophysics, 2: 179-82(Fall 1966).
Translated from Astrofizika, 2: 345-54(Fall 1966).

The results are given of autocorrelation and spectral analyses for a long series of observations of the brightness of SS Cyg, Z Cam, and RU Peg. The computations of the normalized autocorrelation functions were made using a formula given in the text. It is suitable for an autocorrelation analysis of extended series with gaps and an arbitrary time distribution of observations, when these series reflect the basic statistical patterns of the process and the maximum autocorrelation interval is considerably shorter than the duration of the series. The computations were made on a M-20 electronic computer using two programs: with unit intervals of $1^{d}_{.}0$ and $0^{d}_{.}1$ and differences from 1 to 100 intervals. The autocorrelation functions of the three variables investigated are similar. They indicate a random and stationary character for the observed processes of light variation. (auth)

3173 SPECTROSCOPIC AND PHOTOMETRIC OBSERVATIONS OF PECULIAR STARS NOTED ON SOUTHERN OBJECTIVE PRISM PLATES. Hiltner, W. A. (Univ. of Chicago); Stephenson, C. B.; Sanduleak, N. Astrophys. Lett., 2: 153-6 (Nov. 1, 1968).

Slit-spectroscopic data and photoelectric photometry are given for four southern stars whose spectra were found to be unusually interesting on objective prism plates. These include one of the brightest probable white dwarfs now known, and three emission-line stars in which the emission was weaker or absent in the recent past: a shell star, a Be star, and the remarkable star HD 87643 which, though of about the same brightness as when recorded in the HD catalogue, exhibited in May 1968 a spectrum very like a slow nova near maximum. (auth)

3174 THE CARBON ABUNDANCE OF POPULATION II STARS. Cohen, J. G. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. Lett., 2: 163-4(Nov. 1, 1968).

Curve of growth analyses available to date for Population-II stars have indicated that carbon is more deficient relative to the Sun than iron. A refined treatment, which takes into account stratification and molecular equilibrium, shows that carbon is not more deficient than iron, assuming a solar oxygen-to-iron ratio. (auth)

3175 SHORT-PERIOD VARIABLE STARS. I. A SIMULTANEOUS PHOTOMETRIC AND SPECTROSCOPIC STUDY OF 14 AUR. Chevalier, C. (Institut d'Astrophysique, Paris, France); Perrin, M. N.; Le Contel, J. M. Astrophys. Lett., 2: 175-80 (Nov. 1, 1968).

The results of five nights of photometric measurements and three nights of radial velocity measurements on 14 Aur (HR 1706) are given. On two nights, both of the measurements were done simultaneously. The star is found to be variable with a period of about 2 hr 15 min. The opposite variations in the amplitudes of light curves and radial velocity curves suggest that the pulsation might be nonradial. (auth)

3176 THE Hγ ABSORPTION LINE PROFILE IN CYGNUS X-2. Sofia, S. (Univ. of South Florida, Tampa). Astrophys. Lett., 2: 173-4(Nov. 1, 1968).

The origin of the broad, wingless Hγ absorption line profile observed in Cygnus X-2 was investigated by comparison with theoretical line profiles. The observed profile can be exactly reproduced by Doppler broadening of a strong, narrow line if the absorbing material (in the atmosphere of a star whose limb darkening constant $\beta = 3.8$) undergoes radial turbulent motions with a step function velocity distribution up to a maximum velocity of 1400 km/sec. (auth)

3177 VIBRATIONAL AND SECULAR STABILITY NEAR DYNAMIC INSTABILITY IN A STELLAR MODEL. Brahic, A.; Schatzman, E. (Institut d'Astrophysique, Paris). Astrophys. Lett., 2: 165-8(Nov. 1, 1968).

The exact eigenvalues for the nonadiabatic oscillations of a stellar model are calculated, using an artificial damping term. Near dynamical instability it is possible to observe a change from vibrational stability to vibrational instability. Applications to stellar evolution are suggested. (auth)

3178 ASTRONOMICAL EVIDENCE FOR NUCLEOSYNTHESIS IN STARS. Wallerstein, George (Univ. of Washington, Seattle). Science, 162: 625-31(Nov. 8, 1968).

The nuclear reactions of interest to astronomers are reviewed. The most interesting stars may be divided into three rough groups: (i) extremely old, metal-poor stars; (ii) heavy-element and carbon stars; and (iii) hydrogen-poor stars. Some stars belong to two groups. Examples of each group that have been analyzed for chemical composition are described, and it is shown how each peculiar composition may be interpreted in terms of nuclear astrophysics. (W.D.M.)

3179 SPECTROPHOTOMETRIC INVESTIGATION OF THE STAR SS CYG. Bartaya, R. A. (Abastumani Astrophysical Observatory, USSR). Astrophysics, 2: 249-59(Winter 1966).
Translated from Astrofizika, 2: 467-83(Winter 1966).

A spectrophotometric study of the star SS Cyg was made from spectral observations obtained during 1964–1965. Three large flares were observed. Curves showing the changes in monochromatic brightness ΔB, ΔU, in color $\Delta(U-B)$ and in the equivalent widths of the emission lines are given. The characteristic changes in the general appearance of the spectrum are presented, together with distribution curves giving the relative energy in the continuous spectrum as a function of the phase. The results are compared with electrophotometric measurements. It is concluded that at the brightness minimum the spectrum is always that of a G star, accompanied by characteristics which suggest the presence of a gaseous envelope (i.e., emission lines and uv emission). During flares, which are undoubtedly thermal in nature, and which have been assigned to the G component rather than to the B component, the G-star characteristics gradually change until the star has characteristics corresponding to an earlier dA star, or possibly even dB. The considerable increase in brightness of the star leads to the effect that the characteristics of a dA-dB star increasingly dominate, till at maximum only they remain. (auth)

3180 OBSERVATIONAL SELECTION AND STATISTICS OF VISUAL BINARY SYSTEMS. I. ALLOWANCE FOR SELECTION. Fesenko, B. I. (Pskov Pedagogic Inst., USSR). Astrophysics, 2: 260-4(Winter 1966).

Translated from Astrofizika, 2: 485-96(Winter 1966).

It is proposed that all systems be divided into groups on the basis of two parameters, which are independent of distance, in order to take into account observational selection in the statistics of visual binary systems. The first parameter is the difference in the magnitudes of the components; the second depends on the apparent magnitude m of the primary star and the angular separation ρ of the components. It is shown that in the absence of selection with respect to m and ρ the observed distribution of m for the systems of a certain group must correspond to a uniform distribution of the systems in space. A comparison between this distribution and the observed distribution, which is distorted by selection, makes it possible to evaluate the selection effect. The concept of the weight of a system is introduced. It is determined in such a way that the sum of the weights of systems of a particular type corresponds to the number of these systems per unit volume in the neighborhood of the Sun. Using as an example systems with known spectral classes or colors it is demonstrated that systems with more than two components are observed more frequently than double systems. This applies to systems for which the absolute magnitude of the main component falls in the interval $-2^m < M < +7^m$. The results of a statistical study of visual binary systems with known spectral classes for the two components, when the selection effect is allowed for, will be presented in the second part of this paper. (auth)

3181 SPECTROPHOTOMETRY OF NOVA HER 1963. I. OBSERVATIONS DURING 1964 AND 1965. THE NEBULAR STAGE. Doroshenko, V. T. (Shternberg State Astronomical Inst., USSR). Astrophysics, 2: 240-8(Winter 1966).

Translated from Astrofizika, 2: 451-66(Winter 1966).

A spectroscopic study of Nova Her 1963 was made using spectra obtained during 1964 and 1965. It is shown that the fraction of the stellar emission in the observed continuous spectrum is very large, whereas the fraction of the continuous radiation introduced by the envelope is insignificant. An analysis of the continuous and line spectra gives the following values for the physical parameters: density of the envelope $n_e = 4 \times 10^8$ cm^{-3}; electron temperature $T_e = 11{,}500$°K; stellar temperature $T_* \geq 50{,}000$°K; dilution factor $W \sim 2 \times 10^{-13}$; mass of envelope $M_{env} = 8 \times 10^{27}$ g $= 4 \times 10^{-6}$ $M_\odot$. (auth)

3182 SPECTROPHOTOMETRIC STUDY OF THE EMISSION LINES λ 4686, 5411 OF He II IN THE ECLIPSING BINARY WOLF–RAYET STAR V 444 CYG = HD 193576. Guseinzade, A. A. (Shemakhinskaya Astrophysical Observatory, USSR). Astrophysics, 2: 167-74(Fall 1966).

Translated from Astrofizika, 2: 325-37(Fall 1966).

The eclipsing binary Wolf–Rayet star V 444 Cyg (HD 193576) which has a period of $4^d.21238$ was observed spectrophotometrically using the 122-cm telescope of the Crimean Astrophysical Observatory of the Academy of Sciences, USSR, in 1962–1965. A total of 222 tracings of the emission line λ 4686 and 77 tracings of the emission line λ 5411 were obtained in 1964. An analysis of the observational data revealed changes in the equivalent width during the course of a single night, from night to night and from year to year. The emission line λ 5411 undergoes similar changes. Observations with a band width of 30 Å revealed a change in the continuous spectrum, when freed from the influence of emission lines, of about $0^m.7$. On the basis of the frequent changes in the continuous spectrum as compared with the emission lines, it is postulated that the lines are formed by emission and not by recombination. (auth)

3183 CHANGES IN THE POLARIZATION OF β LYRAE. Shulov, O. S. (Leningrad State Univ.). Astrophysics, 2: 175-7 (Fall 1966).

Translated from Astrofizika, 2: 339-44(Fall 1966).

The results of polarization observations of β Lyrae during 1964–1965 are given. The observed polarization changes are attributed to light scattering in a gas stream. (auth)

3184 PERIOD–RADIUS RELATION FOR CLASSICAL CEPHEIDS. Latyshev, I. N. (Leningrad State Univ.). Astrophysics, 2: 183-8(Fall 1966).

Translated from Astrofizika, 2: 355-67(Fall 1966).

The radii of 83 cepheids and one semi-regular variable were determined by a method proposed by the author. A period–radius relation was derived for classical cepheids: $\lg R = (11.926 \pm 0.029) + (0.804 \pm 0.026) \lg P$. Here the radius is expressed in cm and the period in days. Cepheids of the spherical component have radii 2 to 3 times less than classical cepheids of the same period. The semi-regular variable UU Her has a radius similar to the classical cepheids. (auth)

3185 POLARIZATION OF LIGHT IN THE NEBULA IC 446. Parsamyan, E. S. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 189-90(Fall 1966).

Translated from Astrofizika, 2: 369-71(Fall 1966).

Measurements made with the 70-cm meniscus telescope of the Abastumani Observatory revealed that the radiation from the nebula IC 446 is polarized. In the first series it was only possible to measure the central part. For 18 points the mean degree of polarization was ~10% and the position angle $\bar{\theta}$ of the electrical vector was 96°. (W.D.M.)

3186 TWO NEW PLANETARY NEBULAE. Kazaryan, M. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 191(Fall 1966).

Translated from Astrofizika, 2: 371-2(Fall 1966).

Two nebulae, with the coordinates $\alpha = 6^h10^m$; $\delta = +12°24'$ and $\alpha = 19^h59^m$; $\delta = +33°08'$, were discovered on the maps of the Palomar Atlas. The external appearance of the nebulae and the central positions of the stars situated in them indicates that these objects must be planetary nebulae. The distances, total fluxes, angular dimensions, and color indices are given. (W.D.M.)

3187 TRANSFER OF RESONANCE RADIATION IN AN INFINITE MEDIUM. II. Ivanov, V. V.; Nagirner, D. I. (Leningrad State Univ.). Astrophysics, 2: 75-85(Apr.–June 1966).

Translated from Astrofizika, 2: 147-68(Apr.–June 1966).

The source function $S_p(\tau,\lambda)$ was investigated for an infinite homogeneous medium with a point source of radiation. It is assumed that during scattering there is a complete frequency redistribution. An explicit expression for $S_p(\tau,\lambda)$ was derived in the first part of the study. The behavior of $S_p(\tau,\lambda)$ is investigated for the cases $\tau \ll 1$ and $\tau \gg 1$, where τ is the optical distance from the source. Three types of absorption coefficient are considered— Doppler, Voigt, and Lorentz. Particular attention is given to the case of nearly conservative scattering $(1-\lambda \ll 1)$. A physical interpretation of the results is given. The influence of frequency redistribution on the spatial distribution of excited atoms is considered. (auth)

3188 NONEQUILIBRIUM RADIATION DIFFUSION IN A PLANE-PARALLEL LAYER. Engibaryan, N. B. (Inst. of Mathematics and Mechanics, Erevan). Astrophysics, 2: 99-102(Apr.–June 1966).

Translated from Astrofizika, 2: 197-204(Apr.–June 1966).

The nonequilibrium problem in the diffuse reflection of light from a nonhomogeneous plane-parallel layer is considered. In general, the solution of the problem can be reduced to the solution of the nonlinear integral equation together with the inversion of two Laplace transforms. (auth)

3189 NUMBER OF SCATTERINGS DURING PHOTON DIFFUSION. II. Sobolev, V. V. (Leningrad State Univ.). Astrophysics, 2: 119-23(Fall 1966).

Translated from Astrofizika, 2: 239-50(Fall 1966).

Equations were derived for determining the mean number of photon scatterings in a three-dimensional semi-infinite medium. The number of scatterings for photons which are annihilated in the medium and the number of scatterings for photons which emerge from the medium are expressed in terms of the derivatives of the functions $\Phi(\eta)$ and $\varphi(\eta)$ with respect to the parameter λ. Formulas for determining these derivatives are given. (auth)

3190 DIFFUSION OF RADIATION IN A SPHERICAL ENVELOPE SURROUNDING A POINT SOURCE. Germogenova, T. A. (Steklov Mathematics Inst., USSR). Astrophysics, 2: 125-31(Fall 1966).

Translated from Astrofizika, 2: 251-66(Fall 1966).

A study was made of the solution of the transfer equation for a homogeneous and isotropically scattering spherical envelope at whose center there is an isotropic point source. The asymptotic behavior of the solution is established at great distances from the internal surface of the envelope for both finite and infinite external radii of the envelope and the relationship between these two problems is clarified. The dependence of the solution on the internal radius of the envelope is investigated. Particular attention is given to the internal albedo of the envelope. (auth)

3191 DIFFUSE REFLECTION FROM A NONEQUILIBRIUM MEDIUM. Engibaryan, N. B. (Inst. of Mathematics and Mechanics, Erevan). Astrophysics, 2: 133-5(Fall 1966).
Translated from Astrofizika, 2: 267-71(Fall 1966).

The diffuse reflection of radiation from a nonequilibrium plane-parallel layer is considered. The Ambartsumyan invariance principle is applied. The solution of this equation is reduced to the solution of the functional equation and inversion of the Laplace transform. The equation is solved as a class of asymptotic power series, after which the inversion of the Laplace transform is done automatically. (auth)

3192 MODELS OF THE OUTER LAYERS OF HOT MAIN-SEQUENCE STARS. Gorbatskii, V. G.; Kolesov, A. K. (Leningrad State Univ.). Astrophysics, 2: 137-53(Fall 1966).
Translated from Astrofizika, 2: 273-96(Fall 1966).

The pressure and temperature are calculated for the radiative zone of hot stars down the upper boundary of the convective layer stellar masses in the range $1.5 < M_*/M_\odot < 40$, and were used together with radii and luminosities corresponding to main-sequence stars. When $M_* \geq 4\ M_\odot$ there is only one convective zone, caused by He II ionization. The decrease of the adiabatic temperature gradient, associated with He I ionization, is too small and does not produce convection. The optical depth τ_0 of the upper boundary of the convective zone and the physical conditions at this level are determined for different M_*. It was found that τ_0 is insensitive to the helium content when $0.0625 \leq He/H \leq 0.125$. (auth)

3193 SPECTRUM OF AG PEGASI IN 1965. Luud, L. S.; Il'mas, M. E. (Inst. of Physics and Astronomy, Tallin, USSR). Astrophysics, 2: 103-8(Apr.-June 1966).
Translated from Astrofizika, 2: 205-16(Apr.-June 1966).

AG Pegasi is similar to a dense planetary nebula. Its central star is double with components WN 6 and M1-3 II-II. The electron density in the envelope is 10^{-7} cm^{-3}, the dilution factor is 10^{-10} and the Zanstra temperature is about 65,000°K. The envelope has a radius of $10^5 R_\odot$ and its mass is $10^{-3}\ M_\odot$. Electron collisions must be taken into account when computing the Balmer decrement. (auth)

3194 PHYSICAL NATURE OF CONTINUOUS EMISSION IN VARIABLE STARS. Gurzadyan, G. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 109-17(Apr.-June 1966).
Translated from Astrofizika, 2: 217-34(Apr.-June 1966).

The inverse Compton effect, that is, the scattering of infrared photons on fast electrons, whose energy is about 10^6 to 10^7 eV, may be the mechanism responsible for the flaring of variables. The flare itself is a sudden appearance of fast electrons over the photosphere of the star. These electrons cause a transition of the infrared quanta of the photosphere into the region of visual and ultraviolet quanta. No new photons are generated during a flare. The supply of infrared quanta in the spectrum of cool dwarfs of late types is more than adequate to explain the observed amplitude of the brightness fluctuation in such cases. The theory also explains the extremely significant absence of flares in stars of early classes. Light polarization in flaring stars is predicted. The heating of the photospheres by γ radiation, which may appear in the outer layers of the stellar atmosphere as a result of the deceleration of fast electrons in the proton field, is insignificant. (auth)

3195 STUDY OF THE CEPHEUS IV ASSOCIATION. MacConnell, Darrell J. (Case Western Reserve Univ., Cleveland). Astrophys. J., 16: Suppl. Ser. No. 147, 275-98(Oct. 1968).

Membership in the Cepheus IV association was established for approximately forty O and B stars by means of spectral classification and photometry. Among these stars are three known Be stars, an eclipsing binary, and several stars in small reflection nebulosities. A new flare star and a new Be star may also be members. Surface distribution and photometry of a number of faint, variable Hα-emission stars in the region indicates that they are probably stars of T Tauri type associated with the dark cloud which obscures the most luminous members. The correlation between luminosity and reddening is confirmed; the O and early B stars were found only within the cloud, whereas the later B-type stars are found only outside the cloud due to the incompleteness of their detection. The surface distribution of field stars indicates a well-defined border to the cloud, and the ratio of total to selective absorption in the cloud is normal. The distance of the association is 845 pc, and its age is probably less than 2×10^6 years. (auth)

3196 CRITIQUE OF THE HYDROGENIC APPROXIMATION IN THE CALCULATION OF STELLAR OPACITY. Carson, T. R.; Hollingsworth, H. M. (St. Andrews Univ., Scotland). Mon. Notic. Roy. Astron. Soc., 141: 77-108(1968).

The validity of the hydrogenic approximation in the evaluation of atomic energy levels and radiative absorption cross sections used in opacity calculations is critically examined. It is shown that the approximation can be retained with increased accuracy by a careful choice of the parameters, such as screening constants and effective nuclear charges, so as to take proper account of the various contexts in which they occur. The degree of accuracy is tested by the comparison of results with those obtained for the same problem by more-exact but less-facile methods. Application to stellar opacity calculations indicate systematic deviations from the results obtained via the usual hydrogenic approximation. Comparisons are also made with the opacity obtained by more elaborate methods. (auth) (UK)

3197 BLENDING EFFECT IN THE MEASUREMENT OF SPECTROSCOPIC BINARY SPECTRA. Tatum, J. B. (Radley Coll, Abingdon, Eng.). Mon. Notic. Roy. Astron. Soc., 141: 43-55(1968).

When a double line in the spectrum of a binary star is blended there is an apparent displacement of the lines, which might give rise to serious errors in the measured velocities. The theory of this blending effect is discussed, and graphs are presented to indicate the magnitude of the effect under various conditions. It is also shown that, where stellar rotation is the primary cause of line broadening, blending may give rise to a spurious line tripling, which could conceivably lead to gross misinterpretations of the spectrum. (auth) (UK)

3198 THE OPEN CLUSTERS NGC 2483 AND NGC 2489. Lindoff, U.; Johansson, K. (Univ. of Lund, Sweden). Ark. Astron., 5: 45-62(1968).

Photographic magnitudes on the UBV system based on photoelectric sequences were determined for stars in the open clusters NGC 2483 and NGC 2489. For the brightest stars, spectral classes were obtained from objective prism plates. NGC 2483 was rediscovered, and is probably a real star cluster. The B−V colour excess was determined to 0.42^m for NGC 2483 and to 0.40^m for NGC 2489. The distances are 3300 pcs and 1200 pcs, respectively. NGC 2483 is a very young cluster: NGC 2489 is rather old. (auth) (Sweden)

3199 THE OPEN CLUSTERS NGC 2546, Pi 1, NGC 2579, AND Cr 185. Lindoff, U. (Univ. of Lund, Sweden). Ark. Astron., 5: 63-103(1968).

Photographic magnitudes on the UBV system, based on a photoelectric sequence, were determined for the stars in the open clusters NGC 2546, Pi 1, NGC 2579, and Cr 185. Spectral classes for the brightest stars were determined from objective prism plates. The colour excess was determined to 0.17^m for NGC 2546, to 0.51^m for Pi 1, and to 0.21^m for Cr 185. The distances are 980 pcs, 2000 pcs, and 1500 pcs, respectively. NGC 2579 is probably no real star cluster. (auth) (Sweden)

3200 COLOR MAGNITUDE DISTRIBUTION OF GIANT STARS AS A FUNCTION OF AGE. Lindoff, U. (Univ. of Lund, Sweden). Ark. Astron., 5: 23-43(1968).

By means of the yellow and red giants, that are possible members of open clusters, the distribution in the colour−magnitude diagram was studied as a function of age. To provide adequate statistical material the clusters were combined into 11 age groups. The regions in the colour−magnitude diagram, where the observed giants are concentrated, are in general situated lower than demanded by stellar evolution computations. From the number of giants and the number of stars on the upper main sequence the giant lifetimes are estimated for various masses. The time intervals obtained are much lower, down to about 15% of those indicated by the model computations. The various sources of error, inherent in the comparison of observation with theory, are discussed. (auth) (Sweden)

3201 AGES OF OPEN CLUSTERS. Lindoff, U. (Univ. of Lund, Sweden). Ark. Astron., 5: 1-21(1968).

A new method of determining the ages of open clusters is outlined. The relative number of stars in the upper part of the main sequence is taken into consideration and an age parameter, Γ, is introduced. The method was applied to 177 open clusters, for which the age parameter and the resulting ages are given in a Catalogue. Comparisons were made with previous determinations of cluster ages. (Sweden)

3202 MEASUREMENTS OF THE STRENGTH OF Hα IN 951 EARLY-TYPE STARS. Andrews, P. J. (Observatories, Cambridge, Eng.). Mem. Roy. Astron. Soc., 72: 35-99(1968).

Narrow-band photoelectric measurements of the strength of Hα in 951 stars of spectral types O, B, and early A, and all luminosities, were made. The data are compared with other measures of Hα, Hβ, and Hγ. Evidence is presented showing that Hα strength is a good indicator of absolute luminosity. (auth) (UK)

Quasi-Stellar, Radio, and X-Ray Sources

3203 SPECTRA OF RADIO GALAXIES AND QUASI-STELLAR OBJECTS. Shimmins, A. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Astrophys. Lett., 2: 157-62(Nov. 1, 1968).

The differences in radio spectra of two samples of sources which have been identified with either quasars or radio galaxies are discussed. Small but significant differences are found to exist, particularly for frequencies above 1000 MHz. In general, the spectra of radio galaxies are found to steepen at frequencies above 1000 MHz whereas quasars have spectra which are either straight to at least 5000 MHz (approximately 55% of quasars) or show enhancement at high frequencies. (auth)

3204 THE EFFECT OF AN IONIZED MEDIUM ON THE POLARIZATION OF SYNCHROTRON RADIATION. Yukon, S. P. (Air Force Cambridge Research Labs, Bedford, Mass.). Astrophys. Lett., 2: 181-4(Nov. 1, 1968).

The effect of an ionized medium on the degree of polarization of synchrotron radiation from a monoenergetic distribution of electrons is discussed. It is shown that the suppression of radiation at low frequencies due to the Razin effect will be accompanied by a concomitant increase in the degree of polarization. (auth)

3205 RADIO EMISSION OF CTA 21 AND CTA 102 IN THE METER RANGE. Dagkesamanskii, R. D.; Shabanova, T. V. (Physics Inst., Erevan). Astrophysics, 2: 237-9(Winter 1966).

Translated from Astrofizika, 2: 443-50(Winter 1966).

The radio emission from CTA 21 and CTA 102 were measured at a frequency of 86 Mc (3.5 m) using the east–west array of the DKR-1000 radio telescope. The spectra of these radio sources are discussed. (auth)

3206 THEORY OF COHERENT SYNCHROTRON RADIATION FROM COSMIC RADIO SOURCES. Kaplan, S. A. (Gorky State Univ., USSR). Astrophysics, 2: 221-5(Winter 1966).

Translated from Astrofizika, 2: 409-18(Winter 1966).

The intensity of radiation from a system of monoenergetic relativistic electrons in a plasma is computed with reabsorption taken into account. The conditions under which the maser effect in synchrotron radiation is appreciable are determined. It is suggested that small sources of strong radio emission in variable quasars correspond to regions where there are neutral points of the magnetic fields. (auth)

3207 NONTHERMAL RADIO EMISSION GENERATED BY COHERENT PLASMA WAVES. Zaitsev, V. V.; Kaplan, S. A. (Gorky State Univ., USSR). Astrophysics, 2: 87-98(Apr.-June 1968).

Translated from Astrofizika, 2: 169-96(Apr.-June 1966).

Equations were derived which make it possible to evaluate the intensity and effective temperature of nonthermal radio emission formed by scattering and the regular transformation of plasma waves. The mechanisms involved in the excitation of coherent plasma waves by a homogeneous flux (for strong or weak magnetic fields) and by shock waves in "high" and "low" pressure plasma are discussed. The possible astrophysical applications of the results are discussed briefly. (auth)

3208 PULSAR FREQUENCIES AND GENERAL RELATIVITY. Richard, J.-P. (Univ. of Maryland, College Park). Phys. Rev. Lett., 21: 1483-4(Nov. 18, 1968).

The shift of pulsar frequencies due to the general-relativistic corrections to the optical path of photons in the field of the Sun is discussed. Remarks concerning its detection are added. (auth)

3209 MODEL FOR PULSED RADIO SOURCES. McIlraith, A. H. National Physical Lab., Teddington, Eng.). Nature (London), 220: 461-3(Nov. 2, 1968).

An attempt is made to account for the salient features of pulsars by means of a model based on an air of neutron stars forming a binary system. Associated with each star is a plasma which is a directional source of high-frequency radio waves. The rotational motion of the stars about their common centre of gravity accounts for the observed constancy of the pulse repetition frequency, while the shape and time variation of the plasmas account for the shape, power spectrum, polarization, and variability of the pulses. The model operates in accordance with the principles governing the action of the charged-particle oscillator described in Nature 212: 1422 (1966), charged and uncharged particles performing similar oscillations in the gravitational field due to the neutron stars. Because the plasma is formed of counterstreaming charged particles, two-stream instability occurs, and this should lead to electromagnetic radiation at about the electron plasma frequency. The emission of radiation should be strongest from those parts of the plasma where the particle trajectories are about parallel to the contours of constant density. As the refractive index is everywhere less than 1, and is least where the particle density is greatest, all radiation is directed away from the regions of high density. A distant observer close to the plane of rotation of the pulsar would expect to receive two main pulses in each period of pulsar rotation, each pulse containing two subpulses the separation in time of which is governed by the distances between the two plasmas and the angle between the lobes of their respective polar diagrams. For CP 1919, at frequencies >2,000 MHz the signal consists of two well-resolved pulses, whereas at <1,000 MHz the signal is in the form of a band possessing several peaks. The power spectrum expected from this model is similar to that observed; a steady decrease in emitted power with increasing frequency should occur because of the shrinkage of the contours of constant plasma density with increasing density. The model is in accordance with the long-period variation of pulse amplitude being due to scintillations arising from a varying distribution of electrons in the interstellar medium, whereas the pulse to pulse variations are intrinsic to the source. Polarization of the subpulses is expected with this model, since the particle trajectories are grouped close to the plane of rotation of the pulsar. For CP 1133 the two subpulses have been observed to be polarized in different planes; the presence of a weak magnetic field could account for this. Pulsars CP 1919, 1133, and 0834 are considered in this connection. If the oscillating particles are electrons and H ions the energy of the plasma resides almost entirely with the latter, because of greater mass. Mechanisms leading to loss of particles from the oscillating system are discussed. The model fails if gravitational radiation leads to appreciable damping of the rotational motion. (UK)

3210 SOME EXTENDED RADIO SOURCES IN MONOCEROS. Holden, D. J. (Cavendish Lab., Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc., 141: 57-61(1968).

High-resolution observations at 178 MHz were made of the galactic plane near $l^{II} = 205°$. The structure of the Rosette Nebula was in agreement with high-frequency work; from the results, in conjunction with data at 38 MHz, an electron temperature of 8600°K is derived for the Nebula. The Monoceros Nebulosity, whose structure was resolved for the first time, is discussed in detail; its properties suggest that it is a supernova remnant. Other objects observed in the region are discussed briefly. (auth) (UK)

3211 PULSAR SEARCH AT THE MOLONGLO RADIO OBSERVATORY. Large, M. I.; Vaughan, A. E.; Wielebinski, R. (Univ. of Sydney). Nature (London), 220: 753-6(Nov. 23, 1968).

Seven new pulsars have been reported from the Molonglo radio observatory, and some conclusions are drawn about the distribution of pulsars in the galaxy. (auth) (UK)

3212 FREQUENCY DEPENDENT PULSE WIDTHS FOR CP 1133. Craft, H. D.; Comella, J. M. (Arecibo Ionospheric Observatory, Puerto Rico). Nature (London), 220: 676-8(Nov. 16, 1968).

Measurements of average pulse shape showed that the duration of an average pulse from CP 1133 increases progressively with decreasing radio frequency, resulting in a pulse duration at 40 MHz approximately twice that at 430 MHz. The observational results for CP 1133 are presented. It was found that CP 0834 behaves in a similar way, and the effect may be common to all pulsars. Measurements were made with the Arecibo 1000-ft-dia. radiotelescope, and the pulsar was observed at 430, 230, 111.5, 73.8, and 40.12 MHz. Average pulse shapes and the different frequency-dependent behavior of the two observed subpulses suggest that CP 1133 may consist of two sources. Some recent measurements suggest that the observed average pulse may result from a beaming mechanism at the source; a beaming possibility discussed is that of Cherenkov radiation from charged particles spiralling in a magnetoplasma. (UK)

3213 NATURE OF THE PULSATING RADIO SOURCES. Van Horn, H. M. (Univ. of Rochester, N. Y.). Nature (London), 220: 762-3(Nov. 23, 1968).

Pulsations of the nondegenerate envelope of a white dwarf driven by hydrogen burning at the edge of the isothermal core

are considered as a possible model for pulsars. The model provides a natural explanation for the pulsation mechanism and is consistent with observational evidence. (auth) (UK)

3214 FURTHER OBSERVATIONS OF PULSATING RADIO SOURCES AT 13 CM. Ekers, R. D.; Moffet, A. T. (California Inst. of Tech., Pasadena). Nature (London), 220: 756-61(Nov. 23, 1968).

A series of measurements of the pulsating radio sources CP 0834, CP 0950, CP 1133, and CP 1919 is described. (auth) (UK)

3215 SOLAR CORONAL EFFECTS ON PULSAR SIGNALS. Hollweg, J. V. (Max-Planck Inst. fuer Extraterrestrische Physik, Munich). Nature (London), 220: 771-2(Nov. 23, 1968).

It is stated that discovery of the southern pulsar PSR 2045-16 leads to the possibility of detecting an influence of the solar corona on pulsar signals, since this pulsar is located only about 1.5° from the ecliptic and at the end of January 1969 will be located within about six solar radii of the solar center. Estimates are made of the coronal influence by considering the delay produced in the arrival times of the pulses, fluctuations in the arrival times of pulses due to statistical inhomogeneities in coronal electron density, and temporal "smearing" of pulse structure due to wave propagation over different electrical paths. Detection of the first and last of these effects may be possible for PSR 2045-16. (UK)

3216 ABSORPTION LINES IN THE SPECTRA OF QUASI-STELLAR OBJECTS. Roeder, R. C.; Verreault, R. T. (Univ. of Toronto). Nature (London), 220: 772-3(Nov. 23, 1968).

Comments are made on the statement of Weymann and Wilcox (Nature 219: 1031 (1968)) that there is no evidence that the true occurrence of absorption lines in quasars is a function of red shift. Such a conclusion, if true, might be considered as evidence against the screening hypothesis discussed by several authors. The present authors consider that the conclusion of Weymann and Wilcox is not necessarily warranted, and that the available data indicate that the presence of C IV lines in absorption can be explained by the screening hypothesis. (UK)

Solar Phenomena

Refer also to abstracts 3314, 3352, 3362, 3376, and 3386.

3217 (AD-669925) SOLAR WIND DISTURBANCES ASSOCIATED WITH FLARES. Wilcox, John M. (California Univ., Berkeley. Space Sciences Lab.). May 6, 1968. Contract Nonr-3656(26). 32p. (CONF-680531-1). CFSTI.

From 9th Symposium on solar Flares and Space Research, Tokyo, Japan.

The structure of the quiet solar wind and interplanetary magnetic field is reviewed to provide background and perspective for the discussion of solar-wind disturbances associated with flares. Corotating structures with a recurrence period of about 27 days must be distinguished from structures directly produced by flares. Flare-induced discontinuities have been interpreted as low Mach number shock waves; in one such event (which appears to be fairly typical) the solar wind velocity increased from 340 to 385 km/sec, the density increased from 9 to 23 protons/cm^3, and the average temperature increased from 30,000 to 80,000°K. In another event the interplanetary magnetic field strength increased from 12.2 to 20.8×10^5 gauss, and the rms deviation of the orthagonal components of the field approximately doubled. Many interplanetary shock waves appear to be decelerated as they expand and propagate through the solar wind plasma. The most reasonable interpretation appears to be in terms of an intermediate strength shock wave with an energy input in the range of 10^{30} to 10^{32} ergs. (auth) (USGRDR)

3218 (N-68-25986) ESTABLISHMENT OF A LUNAR UNIPOLAR GENERATOR AND ASSOCIATED SHOCK AND WAKE BY THE SOLAR WIND. Sonett, C. P.; Colburn, D. S. (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). 1967. 15p. (CONF-670429-21; NASA-TM-X-60257). CFSTI.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

It is shown that the impact of the solar wind upon a dynamo- and atmosphere-free body such as the Moon generates two distinguishable current systems denoted as Cowling ($\dot{B} \neq 0$) and unipolar ($\dot{B} = 0$). The unipolar system representing the steady state must close through the neighboring plasma and thus has the form of a spherical unipolar generator. The relationship of the current to the conductivity of the body is investigated for the homogeneous and the radially inhomogeneous Moon. The current density is determined by the power flow in the solar wind and the conductivity of the body. The fundamental equation for the interior potential associated with the unipolar generator is solved for a spherical case. (auth) (STAR)

3219 (N-68-29178) ANALYSIS OF FLUCTUATIONS IN THE MAGNETIC FIELD OBTAINED BY IMP-2. Kawashima, Nobuki (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1968. 10p. (NASA-TM-X-63275; X-616-68-271). CFSTI.

Data from the IMP-2 magnetic experiment obtained in interplanetary space were analyzed to study the character of the fluctuations in the magnetic field from the magnetohydrodynamic point of view. The fluctuation in interplanetary space is quite anisotropic relative to the steady magnetic field, with the fluctuations transverse to the magnetic line of force much larger than the longitudinal component of fluctuations. This anisotropy gradually decays as the amplitude of the fluctuation increases, and tends to become rather isotropic. (auth) (STAR)

3220 ON THE POLARIZATION AND INTENSITY DISTRIBUTION OF SOLAR BURSTS AT 7 GHz. Kaufmann, P.; Matsuura, O. T.; Marques Dos Santos, P.; Monte Mascaro, A. C. (Mackenzie Univ., Sao Paulo, Brazil). Astrophys. Lett., 2: 149-52(Nov. 1, 1968).

Flux and polarization distributions of microwave solar bursts were studied with data collected during 14 months of observations in a period of moderate solar activity. The existence of a class of unpolarized bursts is suggested, and it is further shown that the most intense events generally present a lower degree of polarization. (auth)

3221 BALLOON OBSERVATIONS OF THE FAR-INFRARED SPECTRUM AND BRIGHTNESS TEMPERATURE OF THE SUN. Gay, J.; Lequeux, J.; Verdet, J. P.; Turon-Lacarrieu, P.; Bardet, M.; Roucher, J.; Zeau, Y. (Observatoire de Paris, Meudon, France). Astrophys. Lett., 2: 169-72(Nov. 1, 1968).

The first spectra of the Sun in the 50 to 200-micron wavelength range are presented. A study of the absorption lines of residual water vapor gives values for the vertical amount of precipitable water as low as 0.022 micron at an altitude of 28.4 km and 0.077 micron at 25.0 km. Temperatures of the Sun agree with the Bilderberg Continuum Atmosphere between 100 and 200 microns and are higher between 50 and 100 microns. (auth)

3222 INERTIAL COOLING AND TEMPERATURE ANISOTROPY IN THE SOLAR WIND. Khokhlov, M. Z. (Radio Engineering Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 261-2(1968).

Translated from Geomagn. Aeron., 8: 330-1(1968).

It is concluded that the longitudinal temperature of the solar wind decreases under the effect of inertial forces ("inertial cooling" of the solar wind). It is significant that, in this case, the average temperature of the wind also decreases. This is what makes the effect of inertial cooling different from the decrease in the transverse temperature owing to the conservation of the first adiabatic invariant, when the average temperature of the wind remains constant or decreases only slightly if wind velocity increases with distance from the Sun. (W.D.M.)

3223 DRAWINGS OF THE SOLAR CORONA. Eddy, John A. NCAR (Nat. Cent. Atmos. Res.) Quart., No. 19, 5-8(Fall 1967).

A brief history and analysis of drawings of the solar corona are presented. NCAR's High-Altitude Observatory has been collecting drawings and photographs of the solar corona made during eclipses of the last 2 centuries. The intent has been to secure a collection, illustrative of change in the corona, against which modern coronal theory could be tested. (Meteorol. Geoastrophys. Abstr.)

3224 WAVINESS OF TAIL RAYS OF COMET MOREHOUSE 1908 III. Schlosser, Wolfhard; Hardorp, Johannes (Hamburger Sternwarte, Hamburg). Z. Astrophys., 69: 228-41(1968). (In German).

From the wavy structure of 91 rays in the ionic tail of comet Morehouse, the directional fluctuation of the solar wind at 46° heliographic latitude was derived. In a plane containing the tail-axis, a dispersion in direction of 0.7° ± 0.2° with a characteristic time of 30 ± 5 minutes was found, which is considerably lower than the directional dispersion of 1.9° found in the ecliptic plane by the Vela satellites. From the lag of the tail axis behind the radius vector a bulk speed of the solar wind of 500 ± 80 km/sec is derived as an average over 20 nights. (auth)

3225 FRAUNHOFER LINES WITH HYPERFINE STRUCTURE. Heide, Klaus V. D. (Hamburger Sternwarte, Hamburg). Z. Astrophys., 69: 220-7(1968). (In German).

The influence of hyperfine structure on solar abundances for

V, Mn, Co, Cu, and Ba was determined. Futhermore, it is shown that hyperfine structure should not be neglected in differential abundance determinations. (auth)

3226 THE CORONA AT THE TOTAL ECLIPSE OF NOVEMBER 12, 1966. II. ELECTRON DENSITY, POLARISATION, TEMPERATURE, AND MONOCHROMATIC EMISSION. Waldmeier, M. (Eidgenoessische Sternwarte, Zurich). Z. Astrophys., 69: 193-213 (1968). (In German).

The intensities of the white light corona, were separated into the components K and F. A revised method was used for this separation. The intensities of the K component are given and the electron densities deduced therefrom. The corona shows a strong N–S-asymmetry; in its innermost parts, $r < 1.4$, the density of the northern corona is about twice that in the corresponding points of the southern corona. It is only in the outer parts ($r > 1.4$) of the long southern streamers that the density is larger than in the corresponding northern points. From the electron density the polarized component $P \cdot I_K$ was computed. The calculated and observed values are in close agreement, apart from an unexplained discrepancy in the NE quadrant. According to the new decomposition of the corona's light, higher values of the hydrostatic temperature are coming out; its overall mean amounts to 1.92×10^6 degrees. N_e and T are used to compute the emission in the line 5303 Å. The calculated and the observed intensities are presented. There is a remarkably good agreement, not only in the variation along the Sun's limb, but also in the absolute values. (auth)

3227 GENETIC INTERPRETATION OF SOLAR SYSTEM NUCLEAR ABUNDANCES. Suess, Hans E.; Zeh, H. Dieter (Univ. of California, San Diego, La Jolla). Naturwissenschaften, 55: 477-82(Oct. 1968).

An approach to the problem of the origin of the elements similar to that originally suggested by Suess and Urey (Rev. Mod. Phys., 29: 547(1965)) is used in an attempt to interpret the solar system nuclear abundances. Topics discussed include nuclear abundances and empirical correlations, basic concepts of nucleosynthesis, and interpretations and applications of empirical abundance rules. (W.D.M.)

3228 ELEVEN YEAR CYCLE OF SOLAR FLARES AND GEOMAGNETIC CROCHETS. Pinter, S. (Geophysical Inst., Hurbanovo, Czech.); Knoska, S. Bull. Astron. Inst. Czech., 19: No. 1, 40-42(1968). (In Czech).

The occurrences of solar flares (F_p) and those of geomagnetic crochets during the most recent solar-cycle period were examined. The 11-year curve of index F_p was found to be similar to that of type-IV radio emissions, showing yearly variations with a maximum in August and September and a minimum in February. The curve of index F_p was also found to be in good agreement with that of the occurrence of geomagnetic crochets during the last 11-year solar cycle period. Only 3% of flares led to crochets during this period; the closest correlation was between crochets and 3 and 3+ importance flares. The relationships found between the flares and crochets are said to confirm the existence of a close relationship between the generation of x radiation and the development of flares in the Hα line. (ATD)

3229 EXPERIMENTAL TRANSITION PROBABILITIES AND THE SOLAR ABUNDANCE OF COPPER. Kock, Manfred; Richter, Johannes (Univ., Kiel). Z. Astrophys., 69: 180-92 (1968). (In German).

Relative transition probabilities of some Cu I and Cu II lines, including the resonance lines, were measured under LTE conditions from the emission of a wall-stabilized electric arc. By means of the known decay time of the resonance lines, the measured relative values were converted into absolute values. A new determination of the solar copper abundance leads to log $\epsilon_{Cu} = 4.16$. (auth)

3230 LEVEL-BROADENING CONSTANTS FOR MgI AND SiI. Warner, Brian (Univ. of Texas, Austin). Z. Astrophys., 69: 161-7(1968).

Values of the radiation, Stark and van der Waals level broadening constants were calculated from the oscillator strengths and wave functions previously computed by the author. (auth)

Galaxies

Refer also to abstract 3310.

3231 CORRELATION OF THE RADIO EMISSION FROM BARRED GALAXIES WITH THE APPEARANCE OF THEIR CENTRAL REGIONS. Tovmasyan, G. M. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 226-30(Winter 1966).
Translated from Astrofizika, 2: 419-29(Winter 1966).

A comparison of the results of radio and optical investigations of 98 barred galaxies revealed that strong radio emission is present in those cases when the galaxies have a starlike nucleus or when there are traces of explosive processes in their central regions. (auth)

3232 COLORIMETRIC MEASUREMENTS OF THE GALAXY NGC 6946. I. Boerngen, F.; Kalloglyan, A. T.; Khachikyan, E. E.; Einatyan, J. A. Astrophysics, 2: 231-6(Winter 1966).
Translated from Astrofizika, 2: 431-42(Winter 1966).

The results of a detailed two-color photometric investigation of the spiral galaxy NGC 6946 are given. A surface-brightness and color-distribution chart for the galaxy is presented. The diaphragm used measured 7′.5 × 7′.5. Brightness and color distribution curves were constructed for concentric rings around the galactic nucleus. There is a strong increase in the blueness of the galaxy from the center to the edge. The galaxy contains about 60 to 70 bright stellar associations. Photometric data on the starlike nucleus and one of the bright associations are given. (auth)

3233 SOME STATISTICAL CHARACTERISTICS OF SUPERCLUSTERS OF GALAXIES. Karachentsev, I. D. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 159-62 (Fall 1966).
Translated from Astrofizika, 2: 307-15(Fall 1966).

The problem of determining the mean sizes and populations of superclusters of galaxies was investigated on the basis of the observed correlations between counts of clusters in closely related directions and on the basis of fluctuations in the numbers of clusters falling within an area of a fixed size. Application of the concepts developed to the distribution of clusters in the region $b \geq +45°$ using the data in Volumes I and II of the Zwicky catalogue gave the following results: the mean diameter of a supercluster is D = 42 Mps, the mean number of clusters in a supercluster is $\nu = 4$ to 12 and the mean distance between the centers of superclusters is $\lambda^{-1} = 64$ Mps. (auth)

3234 POSSIBLE EXPLOSION IN NGC 3955. Tovmasyan, G. M. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 118(Apr.-June 1966).
Translated from Astrofizika, 2: 235-6(Apr.-June 1966).

One of the peculiarities of NGC 3955 is the presence of a relatively bright condensation somewhat to the south of its center, surrounded by a ring of rather regular form and nonuniform brightness. This suggests that an eccentric explosion may have occurred in this galaxy. From a spectrum of the galaxy the time of the explosion was fixed at 6×10^5 years ago. (W.D.M.)

3235 NUCLEI OF SOUTHERN BARRED GALAXIES. Tovmasyan, G. M. (Byurakan Astrophysical Observatory, USSR). Astrophysics, 2: 163-5(Fall 1966).
Translated from Astrofizika, 2: 317-23(Fall 1966).

Results from the study of the nuclei of 73 barred spiral galaxies investigated using the 40″ telescope of the Siding Spring Observatory (Australia) are presented. The observations confirm the existence of definite differences in the structure of the central regions of galaxies as was discovered earlier at the Byurakan Observatory. A new group of split nuclei is defined. Histograms are given showing the distribution of all 134 galaxies investigated in terms of a five-category classification. (auth)

3236 COLLISION OF CLOUDS OF GAS AND DUST. Gidalevich, E. Ya. (Astrophysical Inst., Alma-Ata, USSR). Astrophysics, 2: 155-8(Fall 1966).
Translated from Astrofizika, 2: 297-306(Fall 1966).

The destruction of dust particles in a shock wave is considered. It is postulated that a shock wave is formed due to the collision of two clouds of interstellar gas. The maximum radii of the particles which can be destroyed in a shock wave are determined. Particles of large diameter can pass through a region of hot gas near the wave front until they are totally destroyed. The particle size distribution function was determined. The possibility of double penetration of dust particles through the shock wave front is considered. (auth)

3237 RELATION BETWEEN THE DIRECTION OF THE INTERPLANETARY MAGNETIC FIELD AND STABLE VARIATIONS. Bol'shakova, O. V.; Troitskaya, V. A. (Inst. for Earth Physics, Moscow). Dokl. Akad. Nauk SSSR, 180: 343-6(1968). (In Russian).

Stable variations of the earth electromagnetic field depend not only on local time, but also on cosmic time. This is apparent from the fact that there are cases when the stable variations start and stop simultaneously in different places on the earth sphere, and that sometimes they are absent, altogether. Therefore there must be some factors involved which are connected with interplanetary space. The paper shows by analyzing the available data from IMF-1

(Wilcox, Norman, and Ness, Solar Physics, 89: No. 1 (1968)) and "Pioner 6," that the direction of the interplanetary magnetic field in the plane of the ecliptic is the decisive parameter. The IMF-1 data show that the fluctuations of the direction were much greater than those of the amplitude. The direction of the magnetic field measured from 1 to 14 December, 1963, coincided 7 days out of 14 with that of Parker's spiral. Sometimes it was perpendicular to the sun–earth line. This change of the prevailing direction was found by the authors to be correlated with the change of groups of stable variations. The main direction coinciding with Parker's spiral corresponded to the more prevalent Pc-3 variation (T = 10 to 45 sec); the direction close to the radial corresponded to a variation of the Pc-4 type (T = 50 to 150 sec). A possible explanation of this correlation is given here. Small variations of magnetic field are caused by hydrodynamic vibrations of magnetospheric plasma. Pc variations may be caused by passing around of solar wind, producing surface waves. The latter are transformed into Alfvén resonance waves or magneto-acoustic waves. The surface waves are produced when the interplanetary magnetic field is under an angle to the magnetosphere; when it is perpendicular, the surface waves decay, and stable variations are not observed on earth. It is believed that IMF consists of force line forming tubes of about 10^6 km diameter, intertwined with one another, so that the magnetic field has a complex structure. The observation of the behavior of Pc variations may be used for investigation of the nonuniformity of IMF. (ATD)

3238 THE H II REGIONS IN NGC 1313. Sersic, J. L. (Observatorio Astronomico, Cordoba, Argentina). Z. Astrophys., 69: 242-4(1968).

NGC 1313 is a late Sct galaxy with a complex structure, classified as SB(s)d. A total of 35 H II regions were identified in this galaxy. Rectangular coordinates and diameters for each H II region are given. (W.D.M.)

Cosmology

3239 NEUTRINOS IN ANISOTROPIC COSMOLOGICAL SOLUTIONS. Doroshkevich, A. G.; Zel'dovich, Ya. B.; Novikov, I. D. (Applied Mathematics Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 8: 58-61(July 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 95-9(July 20, 1968).

The singular behavior of weakly interacting neutrinos in anisotropic and homogeneous cosmological models and their influence on the models are discussed. The hypothesis was advanced that the evolution is naturally subdivided into the following stages: (1) practically total equilibrium of all particles, including the neutrinos, and (2) the stage of free neutrinos, the momentum of which increases by virtue of the "blue shift" produced by compression along one axis. Misner (Phys. Rev. Lett. 19: 533(1967)) earlier proposed that the equilibrium period is followed by a stage in which the neutrino influence can be described by using the concept of viscosity. These two views are discussed. (M.O.W.)

3240 MATRIX EQUATIONS FOR RADIATION DIFFUSION. I. Yakovkin, N. A.; Kostik, R. I. (Kiev Univ.). Astrophysics, 2: 197-220(Winter 1966).

Translated from Astrofizika, 2: 379-408(Winter 1966).

A matrix representation of the equations for the diffusion of radiation through a plane layer of finite thickness is presented. Tables are given which greatly simplify the computation of emission line contours for a stipulated distribution of sources without defining the source function. A Doppler absorption coefficient and a complete frequency redistribution of energy in each scattering event are used. (auth)

3241 PERTURBATIONS OF AN ARBITRARY SPHERICALLY SYMMETRIC METRIC. Stachel, J. (Boston Univ.). Nature (London), 220: 779-80(Nov. 23, 1968).

It is stated that most studies on the gravitational collapse of massive bodies have assumed spherical symmetry. This negates the possibility of studying such matters as the influence of rotation on the rate of collapse and gravitational radiation during collapse. The present author indicates a formulation of the equations of motion for arbitrary first-order perturbations around any spherically symmetric metric, so that time-dependent metrics, such as collapsing ones, may be treated if they do not deviate too much from spherical symmetry. The gravitational application is a particular example of a method for treating the quadratic Lagrangian density for a linear tensorial field in a spherically symmetric background space. By working with the Lagrangian density, rather than the tensorial field equations directly, computational difficulties are greatly decreased. The method is outlined for Maxwell's equations in an arbitrary spherically symmetric background metric, followed by a procedure for the gravitational case. (UK)

Planetary Phenomena

3242 (N-68-29124) EXPLORER 35 MEASUREMENTS OF LOW ENERGY PLASMA IN LUNAR ORBIT. Serbu, G. P. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). June 1968. 14p. (NASA-TM-X-63267; X-615-68-232). CFSTI.

A planar multigrid sensor, programmed as a retarding potential analyzer, was used to measure low-energy plasma, E < 500 eV, during lunar orbits of Explorer 35. The collector current was measured by a logarithmic electrometer which is sensitive to both current polarities in the range from 1×10^{-6} to 3×10^{-12} amperes. Electron current–voltage characteristics are depicted to illustrate the variations in current magnitude, and changes in satellite potential, as the satellite moves from sunlight into the lunar shadow. A series of sequential time observations are presented to show the systematic variation in the measured electron currents as a function of orbital position through the lunar shadow. Data are tabulated on lunar plasma void observations, deduced from the observed gradient in the electron plasma density ratio and changes in the satellite-to-plasma potential. Preliminary analyses indicate: (1) no clear evidence exists for a lunar ionosphere at altitudes in excess of 825 km above the surface, and (2) a characteristics variation in satellite-to-plasma potential is observed as a direct consequence of solar illumination. (STAR)

Atomic and Molecular Physics

Refer also to abstracts 2724, 3229, 3230, 3669, 3824, 4009, 4020, and 4034.

3243 (BMwF-FBK-68-34) CALCULATION OF TRANSITION PROBABILITIES IN ARGON. Meiners, H. (Technische Hochschule, Hanover (West Germany). Institut fuer Plasmaphysik). July 1968. 31p. (In German). Dep.

The absolute scaling factor σ^2 is computed from Hartree–Fock–Slater wave functions. The results are compared with the results of Coulomb approximation according to Bates and Damgaard as well as with experimental data. From the discussion of those transitions showing considerable differences between the results of Coulomb approximation and Hartree–Fock–Slater computations a criterion for the nonapplicability of the Coulomb approximation in certain cases is deduced. Especially the reasons for the well known failure of this approximation for the prominent Ar I transition $3p^54s \rightarrow 3p^55p$ are shown. For a great number of further transitions of the argon spectrum the absolute scaling factors σ^2 computed from Hartree–Fock–Slater wave functions are tabulated. (auth)

3244 (CONF-670655-1) THE CALCULATION OF STOPPING POWER AND BACKSCATTER EFFECTS IN ELECTRON PROBE MICROANALYSIS. Technical Report No. 221. Duncumb, P.; Reed, S. J. B. (Tube Investments Research Labs., Hinxton Hall (England)). May 26, 1967. 35p. Dep.

From Seminar on Quantitative Electron Probe Microanalysis, Washington, D. C.

The problem of calculating backscatter factors and stopping power for atomic number corrections in quantitative microprobe analysis is discussed. It is concluded that the stopping power S is best calculated from Bethe's formula, using values of the mean ionization potential J determined empirically from analyses of known compounds. A table of J values for practical calculations is given. Values of the backscatter factor R are also given from calculations, using Bishop's experimental measurements of electron backscattering coefficients and energy distributions. Simplifications of the theory are discussed, together with methods of averaging S and R for compounds. The accuracy and range of application of the atomic number correction are considered, and areas where further experimental work might lead to useful improvements are indicated. (auth)

3245 (CONF-671066) 20TH ANNUAL GASEOUS ELECTRONICS CONFERENCE, SAN FRANCISCO, OCTOBER 18–20, 1967. PROGRAM AND ABSTRACTS OF PAPERS. Topical Conference of the American Physical Society. (Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Palo Alto Research Lab.). 155p.

3246 (HMI-B-77) KINEMATICS OF ION–MOLECULE REACTIONS. Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Oct. 1968. 63p. Dep.

The details of the reaction mechanism for ion-molecule reac-

tions are covered. The polarization theory is presented and its limitations and agreement with experimental data are shown. Several types of direct reaction theories and the energy ranges at which they are applicable are discussed and compared with the experimental results. Finally, examples are presented of reactions which show a change from a direct to a complex mechanism as the relative energy is decreased. (M.H.R.)

3247 (IPNO/LA-68/19) EXACT DETERMINATION OF THE COULOMB AMPLITUDE BY S-MATRIX METHODS. Artru, X.; Fontannaz, M.; Omnes, R. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). July 1968. 40p. Dep.

An extension of the S-matrix methods to the case of the exchange of zero-mass particles allows one to determine the Coulomb scattering amplitude and the levels of the hydrogen atom completely. One starts from the special analytic properties in t due to the zero mass of the photon, and writes the amplitude as an entire function of $\ln t$. Two of the main assumptions are: the amplitude is of exponential type with respect to $\ln t$; and the partial wave amplitude has only Regge poles in λ. Several classes of solutions are found. One of them is the Schroedinger solution. The others lead to ghosts or to bound states in the e-p system and are therefore discarded. The same method can be extended to the nonrelativistic problem with spin and leads to the same result as in the case without spin. In the relativistic case, the results do not agree with the Dirac and Klein-Gordon solutions. (auth)

3248 (ISS-68/14) INTRODUCTION TO RADIATION PHYSICS. CHAPTER 8, PART 1. Amaldi, U. Jr. (Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). May 3, 1968. 82p. (In Italian). Dep.

This issue is devoted to the description of the interactions of charged particles with matter, and in particular to collision losses which cause excitations and ionizations of atoms and molecules and produce secondary electrons. (auth)

3249 (ISS-68/23) INTRODUCTION TO RADIATION PHYSICS. CHAPTER 8, PART 2. Amaldi, U. Jr. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). July 10, 1968. 111p. (In Italian). Dep.

The concepts of mean energy per ion pair and of linear energy transfer are introduced and the radiation of quanta in the electric field of atomic nuclei is described. A discussion of the ranges of heavy particles and electrons concludes the study of the interactions of charged particles in matter. (auth)

3250 (JINR-P1-4036) π^--MESONS CAPTURE IN THE GAS MIXTURE OF HYDROGEN WITH DEUTERIUM. Petrukhin, V. I.; Prokoshkin, Yu. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 10p. (In Russian). Dep.

The π^--meson transfer from the hydrogen to deuterium in the gas mixture $H_2 + D_2$ was investigated. The observed peculiarities of the capture can be explained within the framework of the phenomenological model. (auth)

3251 (JINR-P1-4081) PATHS AND IONIZATION LOSSES OF THE PROTON ENERGY IN DIFFERENT MATTERS. Vasilevskii, I. M.; Karpov, I. I.; Petrukhin, V. I.; Prokoshkin, Yu. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 27p. (In Russian). Dep.

By the Bragg curve method the 660-MeV proton paths in C, Al, Cu, and Pb are measured. By using the differential ionization chamber the relative ionization losses of the proton energy are determined for different matters in the energy range 100 to 600 MeV. The experimental results are in agreement with the theoretical values at the ionization potentials equal to $I_C = (82.5 \pm 1.3)$ eV, $I_{Al} = 160$ eV, $I_{Cu} = (323 \pm 5)$ eV, $I_{Sn} = (518 \pm 13)$ eV, $I_{Pb} = (826 \pm 14)$ eV. (auth)

3252 (LA-tr-68-45) HIGH INTENSITY LITHIUM ION SOURCE. Septier, A.; Leal, H. Translated by T. Watt for Los Alamos Scientific Lab., N. Mex., from Nucl. Instrum. Methods, 29: 257-60(1964). 16p. Dep. CFSTI.

A lithium ion source having an efficiency approaching 100% has been constructed in the form of a triode gun, using the thermionic emission properties of a lithium salt (β-eucryptite). The emitting surface is heated by electron bombardment. A current of 15 mA is obtained with an accelerating voltage of less than 10 kV. The low working temperature of the source (about 1200°C) thus prolongs the life of the emitter to several tens of hours. The beam leaving the source has a cross section of 4×1 cm^2 and a relatively small angle of divergence. (auth)

3253 (N-68-27538) CLASSICAL APPROXIMATION FOR IONIZATION BY HEAVY PARTICLE IMPACT. Garcia, J. D.; Gerjuoy, E.; Welker, Jean E. (Pittsburgh Univ., Pa. Dept. of Physics). [1966]. 3p. (NASA-CR-81435). CFSTI.

From 5th International Conference on Physics of Electronic and Atomic Collisions, Leningrad, USSR.

An assessment is made of a classical binary approximation method which is based on a knowledge of the differential cross section for the exchange of energy in the lab frame between two charged particles of unequal mass, averaged over all velocity orientations of one particle. An expression is derived for the ionization cross section for proton impinging upon an atom; the resultant cross section is then to be averaged over the velocity distribution of the bound electrons. Specific contributions to the method are described as (1) the use of the exact expressions for the differential cross section, avoiding any approximation, and (2) the use of the quantum-mechanically correct velocity distribution for the bound electron in the case of ionization of hydrogen by proton impact. (auth) (STAR)

3254 (N-68-27614) MODIFIED OPTICAL-POTENTIAL APPROACH TO LOW-ENERGY ELECTRON-NEON SCATTERING. Chang, E. S.; Pu, R. T.; Duxler, W. M. (California Univ., Riverside. Dept. of Physics). [1967]. 15p. (NASA-CR-85630). CFSTI.

The modified optical potential approach, successfully applied to electron-helium elastic scattering, is extended to the problem of electron-neon scattering. Qualitative agreement with experiments in the energy range from 0.5 to 8.7 eV is obtained, using just the direct part of the dipole second-order potential. This calculation improves over the static exchange approximation by accounting for the polarization of the atom and by not invoking the adiabatic approximation. (auth) (STAR)

3255 (N-68-27911) UNIQUE ION GUN TO BE USED IN THE STUDY OF ION DETECTORS. Lackner, Henry A.; Wood, George M. Jr. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). [1967]. 5p. (NASA-TM-X-60140; CONF-670534-6). CFSTI.

From 15th Annual Conference on Mass Spectrometry and Allied Topics, Denver, Colo.

A prototype ion detector, developed to extend the range of measurement of ion detectors to 10^{-19} amperes, has a positive ion beam that is periodically interrupted for several microseconds, which is the equivalent of superimposing a pulsed negative beam with the same magnitude of charge density and current as the positive beam. The experimental apparatus is essentially a duo-plasmatron that has been modified by increasing the distance between the intermediate electrode and anode, as well as by repositioning the filament nearer the opening in the conical portion of the intermediate electrode. This permits operation at lower than normal pressures and prolongs filament life by reducing arc current. Pulses produced by the detector for several deflection pulse durations are shown. It is noted that the detector method was tested with ion beam energies up to 2000 V with good results; and that the system is being redesigned to include a 36.6 cm detector, improved electronics, and an ion source capable of operation at lower pressures. (STAR)

3256 (N-68-27914) POTENTIALS FOR $He^+ + Ar$ AND $He^+ + Ne$ DEDUCED FROM ELASTIC SCATTERING DATA. Smith, Felix T. (Stanford Research Inst., Menlo Park, Calif.). [1967]. Contract NASr-49(07). 3p. (NASA-CR-85719). CFSTI.

Two sets of data were replotted together for the elastic scattering of He^+ on Ne and Ar: the results in the energy range 10 to 600 eV, and in the range 25 to 100 keV. In the latter case, the total pseudoelastic cross section was used (irrespective of the final charge state or excitation level of the He) as best representing the deflection of the projectile He^{2+} as it passes through the field of the scatterer. The data showed great internal consistency, providing empirical confirmation of the scaling law and allowing the potential to be deduced. Simple exponential forms are given to express the effects of shell structure prominent in the screening. Screen lengths deduced from these data are compared with predictions of a simple hydrogenic model in which they are related to the closed shell ionization potentials. An equation is derived for fitting the deviation from the simple repulsive curve and the rainbow angle, using a polarization term with screening as the outermost shell of the target is penetrated Estimates of the polarizability are given and compared with calculated values. (STAR)

3257 (N-68-28293) HEAVY PARTICLE COLLISIONS. Smith, Felix T. (Stanford Research Inst., Menlo Park, Calif.). [1968]. Contract NASr-49(07)05-019-907. 22p. (NASA-CR-95352). CFSTI.

An overview of heavy-particle collisions is limited to diatomic collisions and focused on the energy range above the thermal one;

and the principal processes considered are elastic scattering and inelastic processes involving electronic excitation, ionization, and electronic energy or charge transfer. The types of phenomena being measured as well as the information these measurements provide about interatomic interactions are discussed using illustrative examples. (STAR)

3258 (N-68-28774) DESIGN, DEVELOPMENT, AND EXPERIMENTAL VERIFICATION OF ATOMIC BEAM APPARATUS. Interim Scientific Report, July 15, 1967-April 30, 1968. (American Science and Engineering, Inc., Cambridge, Mass.). June 18, 1968. Contract NAS12-143. 47p. (NASA-CR-86062; ASE-1946). CFSTI.

An apparatus is under construction to measure the optical radiation produced when beams of ionized particles collide with gas phase neutral molecules or atoms at meteoric velocities. The apparatus is described up to its present stage of development, with test results presented for Ar^+ and Fe^+ ion beams. The system design for the case of $Fe^+ \rightarrow N_2$ is discussed in detail, as is the proposed operating procedure for determining the absolute emission cross sections. These measurements will be started within the next two months, and will be followed by measurements of the emission of radiation in $N_2^+ \rightarrow Ca$ collisions. (auth) (STAR)

3259 (NP-17660) SURFACE AND VACUUM PHYSICS INDEX. Bibliography; Author Index; Subject Index; List of Keywords. Volume 3, No. 8 (1012-1177). Hilsenbeck, D. (ed.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 72p. Dep.

165 articles on various aspects of surface and vacuum physics are listed. Subject and author indexes are included. (M.O.W.)

3260 (ORNL-TM-2222) DETERMINATION OF DIFFUSION COEFFICIENTS OF THERMAL ELECTRONS WITH A TIME-OF-FLIGHT SWARM EXPERIMENT. Nelson, DeVaughn Raymond; Davis, F. J. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 164p. Dep. CFSTI.

Thesis. Submitted by DeVaughn Raymond Nelson to Univ. of Tennessee [Knoxville].

A typical time-of-flight electron swarm experiment was modified by replacing the electric field-ring assembly with a conducting paper cylinder in order to (1) increase the lateral dimension of the swarm region, and (2) remove nonconducting surfaces which become charged with electrons and thereby provide the zero-field condition necessary for thermal electron diffusion and capture studies in gases. A new drift-dwell-drift technique was devised whereby electron swarms were (1) drifted to the center of the swarm region, (2) allowed to dwell there for varying periods of time under field-free conditions, and then (3) drifted to the anode where proper sampling with a differentially pumped electron multiplier detection system allowed the reconstruction of the swarm time-of-arrival distribution. Diffusion coefficients were determined for thermal electron swarms in nine gases. The mean thermal diffusion-pressure ($D_t P$) values were 0.214, 2.01, 0.885, 0.133, 0.294, 0.178, 0.015, 0.253, and 0.281 $cm^2\ \mu sec^{-1}$ torr for He, Ne, Ar, H_2, N_2, CO, CO_2, CH_4, and C_2H_4, respectively. A preliminary investigation of the thermal electron capture rate (αw) of SF_6 gave a value of $0.60 \times 10^{10}\ sec^{-1}\ torr^{-1}$. This value was independent of total pressure over the range of 1 to 5 torr and was found to lie between the best values in the literature. (auth)

3261 (ORNL-tr-1862) TRANSMISSION AND RANGE OF FAST ELECTRONS IN THE ENERGY RANGE 4 TO 30 MeV. Harder, D.; Poschet, G. Translated by Martha Gerrard and K. S. Warren (Oak Ridge National Lab., Tenn.), from Phys. Lett., 24B: 519-21(1967). 3p. Dep. CFSTI.

Transmission coefficients and ranges of fast electrons in C, Al, Cu, Cd, and Pb were measured using a large-area proportional counter. As predicted by diffusion theory for $E_0 \gg M_e C^2$, the parameter $Zm_e C^2/E_0$ governs the shape of the normalized transmission curve and the range-to-pathlength ratio. (auth)

3262 (ORNL-tr-1983) ON THE OPTIMIZATION OF SMALL-ANGLE SCATTERING EXPERIMENTS WITH SPLIT GEOMETRY. Hossfeld, F.; Maier, G. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Z. Angew. Phys., 22: 145-9 (1967). 12p. Dep. CFSTI.

In small-angle scattering experiments with slit-height geometry one measures an intensity distribution due to a scattering function distorted by a correctable slit-breadth effect and the effect of slit height. The influence of a finite range of measured intensity on retrievable information for two limiting types of scattering functions is discussed. The relationship of scattering function, slit-height function, and range of intensity distribution can be used for optimizing measurements and also in the design of apparatus. (auth)

3263 (RHEL/R-164) STRAGGLING DISTRIBUTIONS OF EXTREMELY LARGE ENERGY LOSSES BY HEAVY PARTICLES. Tschalaer, C. (Rutherford High Energy Lab., Chilton (England)). Mar. 1968. 28p. Dep. CFSTI. UK 4s. 6d.

Previous calculations of straggling distributions based on expansions into higher moments are re-examined. They are shown to break down for proton energy losses of over 80% due to particles being stopped completely. By direct integration of simplified propagation equations distribution calculations are continued up to particle losses of 50%. (auth)

3264 (SLAC-Trans-83) IONIZATION ENERGY LOSSES OF RELATIVISTIC PARTICLES PASSING FROM A VACUUM INTO A MEDIUM. Lorikyan, M. P. Translated by Robert Addis for Stanford Linear Accelerator Center, Calif., from Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 1: 259-61(1966). 4p. Dep. CFSTI.

An abstract of the original article appeared previously in NSA 21: 7386. (M.O.W.)

3265 (UCRL-18434) ATOMIC BEAM MEASUREMENT OF THE ISOTOPE SHIFTS IN ^{127}Cs, ^{129}Cs, ^{133}Cs, ^{134}Cs, ^{134m}Cs, AND ^{137}Cs. Wang, Edmond Chen-ching (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 27, 1968. 72p. Dep. CFSTI.

Thesis.

A new atomic-beam technique has been employed to measure the isotope shifts of five radioactive cesium isotopes relative to the stable isotope ^{133}Cs. The shifts (in $10^{-3}\ cm^{-1}$) in the D_1 line are found for ^{127}Cs, ^{129}Cs, ^{134}Cs, ^{134m}Cs, ^{137}Cs, to be +5.9(1.5), +2.8(1.5), +1.8(1.0), -2.2(1.2), -6.0(1.5), respectively. Here a positive sign means that the wave number of the D_1 line for the indicated isotope is greater than that for ^{133}Cs. The normal volume shift is calculated to be $10.7 \times 10^{-3}\ cm^{-1}$ for the addition of one neutron. There is evidence that points to the cancellation of the normal volume effect by the deformation effect as a possible explanation of the smallness of the observed shifts. (auth)

3266 SENFTLEBEN-BEENAKKER EFFECT ON THE HEAT CONDUCTIVITY OF A GAS OF REGULAR OCTAHEDRAL MOLECULES (SF_6,UF_6). Hess, S. (Univ., Erlangen, Ger.). Phys. Lett., 28A: 87-8(Nov. 4, 1968).

For a gas of regular octahedral molecules, terms in the distribution function involving 4th-rank spin tensors should give an important contribution to the Senftleben-Beenakker effect. The resulting magnetic field dependence of the thermal conductivity is stated. (auth)

3267 TOTAL CROSS SECTION FOR PROTON EXCITATION OF H ATOMS. Khandelwal, G. S. (Old Dominion Coll., Norfolk, Va.); Choi, B. H. Phys. Lett., 28A: 124-5(Nov. 4, 1968).

A simple expression is given for the total cross section for excitation to all discrete states of a hydrogen atom by a fast proton. This asymptotic expression is applicable for protons of energy equal to or greater than 25 keV. (auth)

3268 INVERSE PROBLEM IN ATOM-ATOM SCATTERING IN WKB APPROACH. Vollmer, G.; Krueger, H. (Institut fuer Theoretische Physik, Freiburg i. B.). Phys. Lett., 28A: 165-6 (Nov. 4, 1968).

Using the Firsov-Sabatier transform, a quasi potential is defined in WKB approximation which leads to a rather simple way for the solution of the inverse problem to determine the potential from scattering data. (auth)

3269 NUMBER OF SCATTERINGS DURING PHOTON DIFFUSION. I. Sobolev, V. V. (Leningrad State Univ.). Astrophysics, 2: 69-73(Apr.-June 1966).

Translated from Astrofizika, 2: 135-46(Apr.-June 1966).

The basic equations determining the mean number of photon scatterings in absorbing and scattering media were derived. Expressions were obtained separately for the number of scatterings for photons absorbed in the medium and for photons emitted by the medium. The derived formulas were applied to a one-dimensional medium. (auth)

3270 MULTIPLE IONIZATION OF MERCURY BY SUCCESSIVE ELECTRON IMPACTS. Redhead, P. A.; Feser, S. (National Research Council, Ottawa). Can. J. Phys., 46: 1905-13 (Sept. 1, 1968). (NRCC-10252).

Mercury ions of charge multiplicity up to n = 9 have been formed by repeated collisions of slow electrons (less than 150 eV) with ions trapped in an electron beam of high current density ($\sim 5 \times 10^{-2}\ A\ cm^{-2}$). Ion current is observed at electron energies below the ionization potential for all multiply charged ions up to n = 8 and is ascribed to collision sequences involving metastable states of the ions ($eN/eN^m/ee(N+1)$, where N represents an ion of charge multiplicity n). All the breaks observed in the ionization

probability curves for $n \leq 3$ can be explained in terms of collision sequences involving spectroscopically known metastable levels as limiting steps. Measured ionization potentials of the highly ionized species up to $n = 9$ are in reasonable agreement with extrapolation of spectroscopic values. (auth)

3271 O(4) SYMMETRY OF THE HYDROGEN ATOM AND THE LAMB SHIFT. Lieber, Michael (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 2037-54(Oct. 25, 1968).

The O(4) symmetry of the nonrelativistic hydrogen atom is exploited in conjunction with Green's-function methods as a tool for the solution of Coulomb problems. The Bethe logarithm, the principal contribution to the Lamb shift, is treated by this means, and a rapidly convergent series is obtained. This is used to evaluate the Bethe logarithm of the 1S, 2S, and 2P states, and a discrepancy with the most precise previously published value for the 1S state is indicated. The new value is 2.9841285 with an estimated uncertainty of ±3 in the last figure. The discrepancy is beyond the reach of experimental observation at present. (auth)

3272 INFLUENCE OF MULTIPLE SCATTERING ON RESONANT RADIATION. Ter-Mikaelyan, M. L. (Physics Research Inst., Erevan). JETP Lett. (USSR) (Engl. Transl.), 8: 61-3(July 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 100-2(July 20, 1968).

A brief theoretical discussion is given on the radiations from charged particle motion in media with a periodically varying electron density. (M.O.W.)

3273 DESORPTION, DISSOCIATION, AND IONIZATION OF ADSORBED PARTICLES BY SLOW ELECTRONS: CARBON MONOXIDE ON TUNGSTEN. Menzel, Dietrich (Technische Hochschule, Darmstadt, Ger.). Ber. Bunsenges. Phys. Chem., 72: 591-608(Aug. 1968).

Using ultrahigh-vacuum techniques and a mass spectrometer capable of detecting both desorbing ions and neutrals, the particles liberated from an adsorbed layer of carbon monoxide on tungsten by slow electron impact have been investigated. From surfaces covered with carbon monoxide at 100°K, neutral CO molecules and CO^+ and O^+ ions (and a very small amount of C^+ ions) are desorbed by impact of 100-eV electrons. The behavior of the ion currents upon heating and intense electron impact shows that the ionic species originate from two different adsorbed states, which can be interconverted. These are not, however, identical with the pure and $\alpha - CO$ low-temperature states, as is shown by experiments with differently prepared layers; the presented evidence makes it probable that both states belong to the species called $\alpha - CO$. The electron-induced conversion of the two states is analyzed in some detail. Above 350°K only states characterized by O^+ emission remain on the surface. Interaction parameters are given. Threshold measurements result in different values for ions and neutrals and thus support the view expressed previously that the desorbing neutrals form predominantly by excitation into a non- or antibonding neutral state on the surface instead of via Auger neutralization of an ionic surface state. The desorption cross sections of ions and neutrals differ also in their energy dependences at higher electron energies. The implications of these and other findings for the mechanism of the interaction of slow electrons with adsorbed particles and for the existing concepts of the adsorption system CO/W are discussed. (auth)

3274 ANGULAR AND ENERGY DISTRIBUTION OF SECONDARY IONS DURING TARGET BOMBARDMENT WITH ION INCIDENT AT GLIDING ANGLES. Arifov, U. A. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk SSSR, 180: 312-15(1968). (In Russian).

The angular and energy distribution of secondary K^+ ions generated during the bombardment of a heated (1500 to 2000°K) tungsten target with 2 to 3 keV K^+ ions at incident angles of 80 to 85° was determined. The experiments were performed to test the recent theoretical calculations of O. B. Firsov (Dokl. Akad. Nauk SSSR, 169: 1311(1966)). The experimental procedure followed and apparatus used have been described elsewhere. It was found that the experimental results were in good agreement with the theoretically calculated results. (ATD)

3275 STOPPING POWER OF Al, Zn, AND In FOR 0.6 TO 2.4 MeV PROTONS. Leminen, E.; Fontell, A.; Bister, M. (Univ., Helsinki). An. Acad. Sci. Fenn., Ser. A VI, 281: 1-14 (May 1968).

The stopping powers of Al, Zn, and In for proton energies between 0.6 and 2.4 MeV were determined. The protons were accelerated in a van de Graaff accelerator, and the energy loss in the foils was measured with a Fowler-type heavy-particle spectrograph. The estimated maximum experimental errors in the stopping power values were about 2%. The measurements were used as a basis for estimation of the mean excitation energies, and K- and L-shell corrections were derived from Walske's calculations. (auth)

3276 SOME FEATURES OF THE SECONDARY ION EMISSION FROM W–Mo ALLOYS BOMBARDED WITH SLOW IONS. Arifov, U. A.; Gruich, D. D.; Khamidova, Kh. M. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk SSSR, 180: 1075-7(1968). (In Russian).

The energy spectra of ions produced from a 50% W–Mo alloy by bombardment with slow ions were studied in an attempt to clarify the effects of atomic bonds in a crystal lattice on ion dispersion. For the experiments at a vacuum of 5×10^{-8} torr, a 10^{-6}-A beam of K^+ ions was directed at the target at a 55° angle, and the secondary ions were analyzed at a 71° angle of dispersion. The energy analyzer was a 127° cylindrical condenser, and the spectra were recorded on an oscillograph screen. In the first run, ion energies of 490, 340, 230, and 170 eV were used, and the target was heated to 1350°K. The oscillogram showed a low-energy peak due to volatilized and slow secondary ions and two high-energy peaks corresponding to elastic scattering of W and Mo ions. In a second run an energy of 480 eV was used, and the target was heated to 1700°K prior to recording the spectra at 1200, 1500, and 1700°K. Here the tungsten elastic-scattering peak gradually disappeared with increasing temperature, indicating an increasing molybdenum concentration at the target surface, but reappeared when the temperature was lowered to 1300°K and the bombardment continued. Theoretical and experimental data for pure tungsten and molybdenum heated to 2400°K are shown for comparison. (auth)

3277 DETERMINATION OF THE SOLUTION OF THE EQUATION OF THE ELECTRIC FIELD AFFECTED BY A PERMANENT FLUX OF IDENTICAL IONS IN THE "WEAKLY IONIZED" CASE. Atten, Pierre (Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Compt. Rend., Ser. A and B, 267: 548-50(Sept. 9, 1968). (In French).

The method for the numerical determination of the solution of the equation of the field affected by a permanent flux of identical ions is reported. The convergence of the method of successive approximations is justified and the relation between the approximation with finite differences and the solution of the equation is made precise. (tr-auth)

3278 POLARIZATION OF ELECTRON IMPACT LIGHT FROM HELIUM. Whitteker, James Howard. Vancouver, B. C., Univ. of British Columbia, 1967.

Thesis.

The polarization of light from helium atoms excited by the impact of low-energy electrons has been measured for the spectral lines $2\ ^3P - 2\ ^3S$ (10,829 Å) and $3\ ^3P - 2\ ^3S$ (3889 Å). An electron beam carrying a current of 10 μA was directed into helium gas at a pressure of 4×10^{-3} torr or less. Polarization was measured as a function of electron energy in a range from the excitation threshold (~23 eV) to 50 eV. For the $2\ ^3P - 2\ ^3S$ line, this work represents the first reported measurement of this type. There is special interest in the value of polarization near the excitation threshold. The theoretical threshold polarization for both lines studied in this thesis is 36.6%. The observed polarization of the $2\ ^3P$ line rises to 21% near threshold, and by means of a curve fitting procedure may be extrapolated to 32 ± 6%. The polarization of the $3\ ^3P - 2\ ^3S$ line rises to 11% and may be extrapolated to 15 ± 3%. (Disser. Abstr.)

3279 SCATTERING OF ELECTRONS BY COMPLEX ATOMIC SYSTEMS. Lan, Vo Ky; Bely, Francoise (Observatoire de Paris, Meudon, France. Observatoire, Nice). Compt. Rend., Ser. A and B, 267: 533-5(Sept. 9, 1968). (In French).

The solution is given of the algebraic problems encountered in the partial wave treatment of electron–complex atom collisions. Antisymmetric wave functions are used. The expressions of the exchange potentials occurring in the coupled equations are given explicitly as a function of the Racah coefficients and of the parentage coefficients for the configurations. (tr-auth)

3280 VARIATIONAL UPPER AND LOWER BOUNDS ON PHASE SHIFTS. Shimamura, Isao (Tokyo Univ.). J. Phys. Soc. Jap., 25: 971-86(Oct. 1968).

A variational method is developed for the calculation of upper and lower bounds on the phase shifts for the scattering of a particle by a compound system. It is essentially the combination of a generalization of Kato's method with a couple of variational principles, i.e., Kato–Temple's and Kohn's methods. First, the central field version of the theory is applied to the s-wave scattering of an electron by the static potential of a hydrogen atom. A trial function with 10 parameters gives the results accurate to about 10^{-7} radians at the incident energies lower than 0.5 atomic units.

Then rigorous bounds on the phase shifts for the s-wave elastic scattering of an electron by a hydrogen atom are calculated with a 52-parameter trial function. The lower bounds are fairly close to other reliable published data. On the other hand, the upper bounds are not very close to them, and the difference between the two bounds for the wave number k = 0.4 a.u. is 0.029 radians for the singlet scattering, and 0.18 radians for the triplet scattering. (auth)

3281 PIERCE ELECTRODES FOR RIBBON ION BUNCHING. Vecheslavov, V. V.; Meshkov, I. N. Radiotekh. Elektron., 13: 1329-30(July 1968). (In Russian).

Analytical expressions obtained for Pierce electrode profiles were used in studies of 2A-thick ribbon ion beam consisting of particles with the mass and charge e. The mc^2/e and $4\pi\epsilon_0 mc^3/e$, respectively, were assigned as the potential and current magnitude units. Data obtained show that the distribution and electrode shape for the same perveance magnitude I/φ_0 (where I is the current per unit width of a beam and φ_0 is the potential on the boundary of the beam) depends, significantly, on the magnitude of the beam phase volume V_π. (R.V.J.)

3282 APPLICABILITY OF THE LANDAU–ZENER–STUECKELBERG FORMULA TO PERTURBATION INDUCED IN ELASTIC SCATTERING. Matsuzawa, Michio (Tokyo Univ.). J. Phys. Soc. Jap., 25: 1153-5(Oct. 1968).

It is shown that the Landau–Zener–Stückelberg formula is applicable to perturbation induced in elastic scattering between heavy particles and can explain its several features. Inelastic differential scattering is also discussed based on this formula. (auth)

3283 SOLENOIDAL SINGLE-COMPONENT FLOW OF A SINGLE TYPE OF CHARGED PARTICLE. Ogorodnikov, S. N. Radiotekh. Elektron., 13: 1332-5(July 1968). (In Russian).

With regular, nonrelativistic flow of one type of charged particle in the absence of a magnetic field, the distribution of electrostatic potential within the beam can be found from the known particle trajectories. In this article it is shown that for solenoidal flow the distribution of potential within the beam can be found directly without solving the basic equation. The method of solution is illustrated as a example for a two-dimensional flow whose particle trajectory is defined by a cosine function, and in another case, where the particle trajectory is defined by a triorthogonal system. (TTT)

3284 THE MEASUREMENT OF HIGH-ENERGY CHARGE TRANSFER CROSS SECTIONS FOR INCIDENT PROTONS AND ATOMIC HYDROGEN IN VARIOUS GASES AND THE K-, L-, AND M-AUGER, L-COSTER–KRONIG, AND THE CONVERSION-ELECTRON SPECTRA OF PLATINUM IN THE DECAY OF ^{195}Au. Toburen, Larry Howard. Nashville, Vanderbilt Univ., 1968. 241p.

Thesis.

SINGLE-ELECTRON capture and loss cross sections were measured for incident protons and hydrogen atoms, respectively, in the energy range 100 to 2500 keV. The target gases studied were H_2, He, Ar, Kr, N_2, O_2, CO, CO_2, H_2O, CH_4, C_2H_4, C_2H_6, and C_4H_{10}. An incident beam, initially in a single charge state, was passed through a "thin" gas target and the cross sections were measured by observing the growth of a charge-changed component in the beam as a function of the target density. These cross sections were found to vary with incident particle velocity according to a power law for energies above approximately 300 keV except where capture from inner electron shells was evident. Velocity dependences of the cross sections were found to agree approximately with Bohr's predictions. A sum rule was used to calculate the cross sections for complex molecules from the cross sections of their constituents and found to give semi-quantitative results for the molecules studied. Double-electron capture cross sections were measured for incident protons with energies in the range from 75 to 250 keV and for the target gases H_2, He, Ar, Kr, N_2, and H_2O. The results were found to join smoothly to previous measurements at lower and higher energies and to agree closely with previous data for argon which are the only available data in the energy range of the present work. However, wide discrepancies exist between the present work and available theoretical results. The K-, L-, and M-Auger and L Coster–Kronig spectra of platinum in the electron capture decay of ^{195}Au were measured by means of the Vanderbilt iron-free, double-focusing spectrometer. Relative intensities and energies of 55 peaks were measured in the L-Auger spectrum in the energy region 5 to 12 keV. The measured intensities were compared to those calculated theoretically for silver by Asaad. The total L Coster–Kronig plus M-Auger electron intensity (0 to 3.25 keV) was measured relative to the L-Auger intensity. A comparison of measured K-Auger energies and intensities to theoretical and experimental results of others was made. The measurement of the $KL_3L_3(^3P_0)/KL_3L_3(^3P_0 + {}^3P_2)$ ratio is the first reported in this region of atomic numbers. Twenty-four internal conversion lines in the decay of ^{195}Au were studied at high resolution by means of the Vanderbilt spectrometer. The K-conversion line of the 210-keV transition, reported here, has not been observed before. By means of the theoretical K-conversion coefficient of the 129.8-keV transition and previously reported gamma-ray intensities, conversion coefficients were calculated for all other transitions. These data were also used to calculate the electron capture branching ratios. The calculated conversion coefficients and the L-sub-shell ratios were used to assign multipolarities to the transitions in ^{195}Pt. The L-subshell ratios show deviations from theory by as much as 25 to 35%. (Disser. Abstr.)

3285 ANGULAR DISTRIBUTION IN INELASTIC ATOMIC COLLISIONS. Kotova, L. P. (Inst. of Chemical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 1375-82(1968). (In Russian).

Formulas are derived for the inelastic scattering differential cross section in the approximation of two interacting terms. The formulas are employed for analyzing scattering of He^+ on Ne. It is shown that the slope of the inelastic interaction potential at the point of intersection of the terms can be determined on basis of the oscillation period of the inelastic cross section. (auth)

3286 FREQUENCY DEPENDENCE OF THE HIGHER SUSCEPTIBILITIES. Sitz, Paul; Yaris, Robert (Washington Univ., St. Louis). J. Chem. Phys., 49: 3546-57(Oct. 15, 1968).

Expressions for the susceptibilities appropriate to third harmonic generation, second harmonic generation, and the induced Kerr effect are derived using time-ordered time-dependent perturbation theory. These expressions are used to calculate the susceptibilities for atomic hydrogen and helium. A six-pole trial function is used to obtain for He: $\lambda = 6943$ Å, $\chi_{zzzz}(-3\omega; \omega, \omega, \omega) = 47.7$ a.u.; $\lambda = 6943$ Å, $\chi_{zzzz}(-2\omega; 0, \omega, \omega) = 45.2$ a.u.; $\lambda = 6328$ Å, $\chi_{zzzz}(-\omega; 0, 0, \omega) = 43.6$ a.u.; $\chi_{zzzz}(0; 0, 0, 0) = 42.6$ a.u. The experimental value of $\chi_{zzzz}(-\omega, 0, 0, \omega)$ obtained from Kerr-effect measurements is 51.6 ± 8.6 a.u. The calculations are checked by the use of a number of sum rules with the largest disagreement being 0.05%. (auth)

3287 DISSOCIATION OF N_2 IN WEAK rf DISCHARGE. Young, Robert A.; St. John, Gilbert A. (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Phys., 49: 3505-7(Oct. 15, 1968).

It has been established that the production of nitrogen atoms from molecular nitrogen by a weak rf discharge is due predominantly to dissociation of a metastable state of N_2 by electron impact. (auth)

3288 PIERCE ELECTRODES FOR CONIC ION BEAMS. Vecheslavov, V. V.; Gorbunov, V. A.; Kononov, V. I. Radiotekh. Elektron., 13: 1472-6(Aug. 1968). (In Russian).

The shape and distribution of electrodes in a Pierce optical system for conic ion beams were determined, considering the thermal dispersion of ion transverse velocities. The numerical equipotential surface was constructed using the K. R. Harker (J. Math. Phys., 4: No. 7, 993(1963)) method, Laplace transformation to the hyperbolic type, and the integral concept of a potential point outside the beam. Graphs are included for electrode geometry selection suitable for practical use. (R.V.J.)

3289 EXPECTATION VALUES OF SIMPLE CORRELATED HELIUM-ATOM WAVE FUNCTIONS. Tsien, Thomas P.; Pack, Russell T. (Brigham Young Univ., Provo, Utah). J. Chem. Phys., 49: 4247-8(Nov. 1, 1968).

Results of a calculation of the expectation values of a number of one- and two-electron properties of the ground-state He atom using two very simple correlated wave functions are presented. Also listed are values given by use of a product of scaled hydrogenic orbitals, Pekeris' 1048-term wave function, and the Hartree–Fock approximation. It is concluded that correlation factors produce only very slight improvement in the values of the one-electron properties, but a large improvement in all two-electron properties. Linear and exponential correlation factors give very similar results. (A.G.W.)

3290 SCATTERING OF $^7Li^+$ IONS BY FREE ATOMS AND MOLECULES. Forst, G. (Jetzt Fachschule fuer Optik und Fototechnik, Berlin). Mol. Phys., 15: 329-31(1968). (In German).

The angular distributions of $^7Li^+$ ions (30 keV) scattered by free rare gas atoms and tetrahedral and diatomic molecules showed characteristic maxima of intensity at scattering angles in the order of $10^{-4} < \vartheta < 10^{-3}$ rad. The scattering angles of the maxima depend on the optical polarizability of the scatterer in a simple manner and can be explained by the polarization of the scattering atoms or molecules by the $^7Li^+$ ions. (auth) (UK)

3291 TEMPERATURE DEPENDENCE OF THE CROSS SECTION FOR THE DESTRUCTION OF THE HELIUM METASTABLE ATOM HE(2^3S) BY ARGON. Jones, C. R.; Robertson, W. W. (Univ. of Texas, Austin). J. Chem. Phys., 49: 4240-1(Nov. 1, 1968).

Cross sections for the destruction of the He metastable atom He (2^3S) by Ar were measured at temperatures of 193, 300, 400, and 500°K. Results are compared with calculations based on various models of the reaction. (A.G.W.)

3292 COLLISION CROSS SECTIONS AND THE PENNING IONIZATION REACTIONS, He(2^3S) + X → He + X^+ + e. Jones, C. R.; Robertson, W. W. (Univ. of Texas, Austin). J. Chem. Phys., 49: 4241-3(Nov. 1, 1968).

Measured and calculated cross sections are compared for the reactions He(2^3S) + X → He + X^+ + e where X is Ar, Kr, Xe, N_2, O_2, H_2, or He(2^3S). Calculated values are given for a Lennard–Jones potential, the rigid sphere, and a pure attractive potential of the form $U(r) = Cr^{-6}$. (A.G.W.)

3293 VARIATIONAL FORM OF VAN VLECK DEGENERATE PERTURBATION THEORY WITH PARTICULAR APPLICATION TO ELECTRONIC STRUCTURE PROBLEMS. Kirtman, Bernard (Univ. of California, Santa Barbara). J. Chem. Phys., 49: 3890-4(Nov. 1, 1968).

The variational equivalent of Van Vleck degenerate perturbation theory is derived. As an example the Stark effect for the 2s and 2p states of a hydrogenic atom is treated. Other applications involving angular momentum degeneracy as well as electronic and nuclear permutation degeneracy are discussed. The existence of interchange theorems is also noted. (auth)

3294 SEPARATION OF ROTATIONAL COORDINATES FROM THE N-ELECTRON DIATOMIC SCHROEDINGER EQUATION. Pack, Russell T.; Hirschfelder, Joseph O. (Univ. of Wisconsin, Madison). J. Chem. Phys., 49: 4009-20(Nov. 1, 1968).

A formalism is presented for the exact separation of the center-of-mass and rotational coordinates from the Schrödinger equation for an arbitrary diatomic system. The use of operator arguments instead of the explicit representations of the rotation group simplifies the procedure. The coupled equations governing the internal motion of the system are obtained and expressed in a new and particularly simple form using angular-momentum raising and lowering operators. The formalism is carried out for three types of electronic coordinates (separated atom, center of mass of nuclei, and geometric center of nuclei) which differ as to the origin of the electronic coordinates. (auth)

3295 INTERCHANGE THEOREMS IN DEGENERATE PERTURBATION THEORY. Kirtman, Bernard (Univ. of California, Santa Barbara). J. Chem. Phys., 49: 3895-3908(Nov. 1, 1968).

The equivalent of Dalgarno's interchange theorems for the case of exact or near degeneracy is derived using Van Vleck perturbation theory. The application to excited states and to calculations based on a "distinguishable electron" method is discussed. (auth)

3296 RELATIVE CROSS-SECTIONS FOR ELECTRON IMPACT EXCITATION OF CALCIUM. Karstensen, Frithjof (Univ., Kiel). Z. Astrophys., 69: 214-19(1968). (In German).

Relative excitation cross sections for 9.5 and 15.5-eV electrons of 19 terms of the Ca atom were determined from measured line intensities using calculated branching ratios. (auth)

3297 ELECTRON-IMPACT EXCITATION OF HYDROGEN LYMAN-α RADIATION. Long, Robert L. Jr.; Cox, Donald M.; Smith, Stephen J. (National Bureau of Standards, Boulder, Colo. Univ. of Colorado, Boulder). J. Res. Nat. Bur. Stand., 72A: 521–35(Sept.–Oct. 1968).

An experimental investigation of electron impact excitation of the 2p state of atomic hydrogen is described. A beam of electrons was passed through a chopped beam of hydrogen atoms in a high-vacuum apparatus. The modulated flux of Lyman-α photons emitted in the radiative decay of the 2p state was taken as a measurement of the excitation probability resulting from direct excitation plus indirect excitation resulting from cascading. The region surrounding the intersection of the two beams was electrically and magnetically shielded to prevent quenching of metastable 2s atoms and thereby to ensure that the observed Lyman-α flux resulted from decay of the short-lived 2p state. The experimental results are consistent with those obtained by Fite, Stebbings, and Brackmann [1959], and confirm the existence of a large discrepancy between theoretical and experimental results in the electron energy range below 50 eV. (auth)

3298 HELICITY GROUP IN THE RELATIVISTIC SYMMETRICAL KEPPLER PROBLEM. Malkin, I. A.; Man'ko, V. I. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 627-30 (Sept. 1968). (In Russian).

It is shown that in the relativistic model of the hydrogen atom presented by Biedenharn there is a helicity symmetry group SU(2) responsible for the double degeneration on the Dirac quantum number. (auth)

3299 CHARACTERISTIC ENERGY LOSSES OF 8-keV ELECTRONS IN LIQUID Al, Bi, In, Ga, Hg, AND Au. Powell, C. J. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 175: 972-82(Nov. 15, 1968).

Characteristic loss spectra have been obtained in a reflection scattering geometry for liquid, Al, Bi, In, Ga, Hg, and Au and, in the case of Al, Bi, and Au, for the same specimens in the solid phase. Peaks due to surface and volume plasmon excitation dominated the loss spectra for all elements except Au. The relative intensity of these peaks varied rapidly with scattering angle for Al, Bi, In, and Ga specimens, but there was little angular variation when Al, Bi, or Au was evaporated onto a frozen substrate of the same element. The Al plasmon losses varied with temperature and changed at the melting point as would be expected from the known density variation. Changes in the Bi plasmon energy losses on melting and changes in other structure on melting have been interpreted in terms of band-structure changes. The peaks in the gold loss spectra appeared to become broader and less distinct on melting, from which it was concluded that the Au excited states had shorter lifetimes with increased disorder. In general, however, the liquid- and solid-state spectra of the same element were similar, thereby showing that for these materials there was not a large change in the electronic structure on melting. (auth)

3300 INFLUENCE OF OPTICAL PUMPING FILTRATION CONDITIONS ON THE FREQUENCY OF 0–0 TRANSITION OF ^{87}Rb ATOMS. Alekseev, E. I.; Bazarov, E. N.; Grigor'ev, V. I. Radiotekh. Elektron., 13: 1041-4(June 1968). (In Russian).

The frequency shift of the transition F = 2, $m_F = 0 \rightarrow F = 1$, $m_F = 0$ of the ground state of ^{87}Rb atoms, dependent on optical pumping, was experimentally investigated. The relation of the frequency shift from the filtration conditions of radiation pumping by a filter containing ^{85}Rb to the efficiency of the pumping was studied. (tr-auth)

3301 VARIATIONS OF THE CHARACTERISTIC 2.5-eV ENERGY LOSS OF ELECTRONS IN GOLD ACCORDING TO THE THICKNESS OF THE SAMPLES. Carillon, Antoine (Faculte des Sciences de Paris, Orsay, France). Compt. Rend., Ser. A and B, 267: 332-5(July 29, 1968). (In French).

It is shown that the variations with sample thickness of the position and the relative intensity of the line near 2.5 eV in the energy-loss spectrum can be interpreted by the excitation of a surface plasmon. (tr-auth)

3302 ELECTRON EMISSION AND ION REFLECTION FROM A MOLYBDENUM TARGET BOMBARDED BY RARE GAS IONS. Perdrix, M.; Paletto, S.; Goutte, R.; Guillaud, C. (Institut National des Sciences Appliquees, Villeurbanne, France). J. Phys., D (London), 1: 1517-28(Nov. 1968). (In French).

An experimental apparatus which enables the attainment of pressures lower than 1 ntorr in the region of the target is described. Details are given of the method used to clean the target and to measure the currents needed to determine the coefficients of electronic emission and ionic reflection. Results for the electronic emission and ionic reflection are given in terms of the adsorption, the energy of the incident ions, the angle of incidence formed by the beam with the target, and the temperature of the target. These measurements were made with He^+, Ne^+, Ar^+ and Kr^+ ions, the energy of which varied from 5 to 30 keV. An interpretation of the results is given, based on a theory of kinetic emission. (auth) (UK)

Cosmic Radiation

Refer also to abstracts 2566, 2706, 3090, 3385, 3675, and 3817.

3303 FLUXES OF FAST NEUTRONS IN THE ATMOSPHERE. Myakinin, E. V.; Romanov, A. M.; Yur'ev, V. V. (Ioffe Inst. of Physics and Tech., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 269-70(1968).

Translated from Geomagn. Aeron., 8: 338-9(1968).

Fluxes of fast (up to 10 MeV) neutrons were measured at various depths in the atmosphere at magnetic latitudes of 40 and 47°N. Use was made for the measurements of proportional counters with BF_3, enriched with the ^{10}B isotope to 82%. The counters were placed in a cylindrical block of transparent plastic with a wall thickness of 40 mm. (W.D.M.)

3304 DETERMINATION OF THE COSMIC-RAY MODULATION SPECTRUM IN INTERPLANETARY SPACE. Dorman, L. I.; Zusmanovich, A. G.; Kolomeets, E. V. (Kazakh State Univ.,

Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 266-8(1968).

Translated from Geomagn. Aeron., 8: 335-7(1968).

It is shown that in the energy interval 1 to 15 BeV the available experimental data agree with the computations of a spherically symmetric dynamic model of the 11-year variation in cosmic rays. The fact that the energy spectrum is less steep in the energy interval 1 to 2 BeV indicates that the exponent in the energy dependence of the diffusion coefficient decreases with decreasing energy of primary particles. (W.D.M.)

3305 METEORIC VARIATION OF COSMIC-RAY INTENSITY. Bel'skii, S. A. (Ioffe Inst. of Physics and Tech., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 183-7(1968).

Translated from Geomagn. Aeron., 8: 230-5(1968).

The fact that cosmic-ray intensity increases on Earth during meteor showers is established. It is shown that the meteoric variation of cosmic-ray intensity has the highest amplitude in years of maximum solar activity and is determined mainly by cosmic-ray particles with an energy of up to ~14 BeV. The assumption is voiced that there are regular magnetic fields in meteor streams. (auth)

3306 QUASI-PERIODIC 13-DAY VARIATIONS OF COSMIC-RAY INTENSITY (1938 TO 1954). Lovera, Giuseppe (Politecnico, Turin). Geofis. Meteorol. (Genoa), 17: 33-7(May-Aug. 1968). (In Italian).

A variation, in cosmic-ray intensity, with a period of about 13 days, has already been selected, by means of the Vercelli's method of periodic analysis, in the records from Observatories at Cheltenham, Huancayo, Christchurch, for two six-month intervals during 1938 and 1944. The presence of this variation has been confirmed by treating, in the same manner, four other six-month intervals during the years 1946 and 1954. The values of the average amplitudes, of the periods, and of the correlation coefficients among the variations in the above localities are given, and their behaviors are discussed. (auth)

3307 ABSORPTION OF THE NUCLEAR-ACTIVE COMPONENT OF COSMIC RADIATION IN LEAD AND ALUMINUM. Bostandzhyan, N. Kh.; Vardumyan, D. T.; Marikyan, G. A.; Matevosyan, K. A. (Erevan Physical Inst.). Dokl. Akad. Nauk Arm. SSR, 45: 200-4(1967). (In Russian).

Nuclear interaction processes at energies $>10^{11}$ eV may be studied by determining the energy spectrum of the nuclear-active component of the cosmic radiation at various elevations above sea level or in various materials by means of an ionization colorimeter. Such studies were carried out at an elevation of 2000 m with a specially built calorimeter; in another series of measurements a block of 85 g/cm^2 of lead or 30 g/cm^2 of aluminum was placed above the instrument. The instrument contained nine pairs of ionization chambers between sheets of iron. The plot of the integral distribution of the frequency during a period of 3000 hours allowed to determine the integral energy distribution of the nuclear component at that altitude. The ratio of the free paths of absorption, L_{Pb}/L_{Al} up to 30 BeV was found to be 1.98. It was noted that this ratio tends to decrease as the number of bursts increases; this is probably due to changes in the correlation between the nuclear interaction and the atomic number of the material and the inelasticity coefficient as the energy of the interacting particles increases. (TTT)

3308 THEORETICAL CALCULATION OF THE COSMIC-RAY SOLAR DIURNAL VARIATION. I. NUCLEONIC COMPONENT. Mori, S. (Franklin Inst., Swarthmore, Pa.). Nuovo Cim., 58B: 1-57(Nov. 11, 1968).

Theoretical calculations of the solar diurnal variation expected at 41 stations for the nucleonic component were made by following the procedure developed by Nagashima, Potnis and Pomerantz and expanded by McCracken, Rao, Fowler, Shea and Smart. The calculations have included the latest differential response functions reported by Lockwood and Webber. It is concluded that the new response functions do not change the final values appreciably. Further, one finds that using weighting factors of counting rates from various zenith angles different from those used by McCracken et al., the expected amplitude and phase are not different. Calculations are also made for maximum solar activity by using our derived response functions at this epoch. Comparing the theoretical calculations for minimum and maximum solar activity, it is found that the expected amplitude increases about (10 + 20)% from maximum to minimum activity for the spectrum exponent $m \sim -1.0$, while for $m \sim 0$ the increase is about 5%. The phase difference between the two epochs is found to be about 5°. The results for various parameters are tabulated. (auth)

3309 THEORETICAL CALCULATION OF THE COSMIC-RAY SOLAR DIURNAL VARIATION. II. MESON COMPONENT. Mori, S. (Franklin Inst., Swarthmore, Pa.). Nuovo Cim., 58B: 58-70(Nov. 11, 1968).

Theoretical calculations of the solar diurnal variation expected at 23 stations for the meson component of the cosmic radiation have been made by following the procedure developed by Nagashima, Potnis and Pomerantz and expanded by McCracken, Rao, Fowler, Shea and Smart. Different sets of weighting factors of counting rates from various zenith angles corresponding to different zenith-angle dependences are examined. It is shown that for all cases the results are not different. Further, it is found that at least for two stations at middle latitude and equatorial regions, the counting rate contributions by particles from deep zenith angle are negligibly small. The calculations for various parameters are tabulated. (auth)

3310 COMPOSITE MODEL OF COSMIC-RAY DIFFUSION AND EJECTION FROM GALAXY-CORE EXPLOSIONS. Rosen, S. (Adelphi Univ., Garden City, N. Y. State Univ. of New York, Fort Schuyler). Nuovo Cim., 58B: 71-85(Nov. 11, 1968).

A two-geometry, two-energy picture of cosmic-ray generation by outbursts of a galaxy nucleus is developed. The very-high-energy ($> \sim 10^{18}$ eV) cosmic particles ejected are assumed to behave as if a point instantaneous source was embedded in an infinite homogeneous medium. This aspect of the model represents the free departure of cosmic rays from the galaxy. The low-energy portion ($\sim(10 + 10^{17})$ eV) of the primary beam ejected by a point instantaneous source, diffuses in a spherical region concentric with the source, and subsequently departs from the spherical boundary into an infinite diffusive medium. The model is consistent with isotropy and the absence of long-term time variations, which imply an age of $(10^7 + 10^8)$ years for a central galactic outburst. The model is consistent with, but not sensitive to other cosmic-ray observations. Detailed study of high-energy gamma rays from the galaxy core, and continued examination of the high-energy cosmic-ray anisotropy are suggested. These observations would reveal structure and processes in the nucleus of our galaxy. (auth)

3311 STUDY OF DIURNAL ANISOTROPY BASED ON DIRECTIONAL MEASUREMENTS OF COSMIC RAY MESONS. Kawasaki, Shinkichi (Inst. of Physical and Chemical Research, Tokyo). Rep. Ionosphere Space Res. Jap., 22: 107-17(June 1968).

Characteristic features of anisotropies in cosmic rays were studied from data obtained during the period 1958–1962 by means of counter telescopes, directed towards the east, west, north, and south, with an inclination of 32° from the zenith. The amplitudes and maximum local times of the diurnal variations of barometer-corrected data were obtained for each direction for every year. In order to eliminate uncertainties due to atmospheric temperature effects and other unknown factors which might be identically affected for each directional component, subtracted diurnal vectors such as east–south, east–west, west–north, and south–north were derived for further analysis. The direction of cosmic-ray anisotropy outside the geomagnetic field was calculated on the basis of these adjusted vectors. In the process of calculation, different sets of numerical values of parameters (the parameter m shows the exponent of the rigidity spectrum of the anisotropy, the parameter P_1 is the upper limit rigidity value and the parameter n determines the asymptotic latitude angle dependence of the observed diurnal variation) were assumed, and the anisotropy specified for each set. It is possible to determine the most suitable set of these parameters by considering whether or not an identical anisotropy could be found from the four subtracted diurnal vectors. It is shown that, on the average, the direction of anisotropy is 90° east of the Sun–Earth line and the rigidity spectrum responsible for the anisotropy is flat. There is evidence of secular variation in that the upper limiting rigidity value decreased. The cutoff was hardly recognizable in 1958, but decreased to less than 50 GV in 1962. (auth)

3312 SECOND HARMONIC OF THE COSMIC-RAY DAILY VARIATION. Quenby, J. J.; Lietti, B. (Imperial Coll. of Science and Tech., London). Planet. Space Sci., 16: 1209-19 (Oct. 1968).

Since on the Parker model for the quiet interplanetary magnetic field the spirals are less tightly wound at high solar latitudes, cosmic rays arriving along the Sun's polar field lines may suffer less modulation than those arriving in the ecliptic plane. Hence a rising cosmic-ray density gradient is expected away from the solar equatorial plane, which gives rise to a second harmonic variation with maxima at right angles to the spiral field direction. A model for the density gradient is considered in which particle diffusion is important only along the field direction and the resulting second harmonic varies as the first positive power of magnetic rigidity in the range 1 to 15 GV. This is shown to be in reasonable accord

with experimental results over the solar cycle from 1957 to 1964. (auth) (UK)

3313 ISOTROPIC GAMMA RADIATION AND THE METAGALACTIC COSMIC-RAY INTENSITY. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, Md.). Nature (London), 220: 675-6(Nov. 16, 1968).

Data from the OSO-3 high-energy gamma-ray experiment indicated an apparent isotropic background flux of gamma rays with energies >100 MeV, the intensity of which is $\leq(1.1 \pm 0.2) \times 10^{-4}$ cm^{-2} sec^{-1} sec^{-1}. A possible source of metagalactic rays is discussed; they may be produced by the decay of neutral π mesons generated in metagalactic cosmic-ray interactions. Two model universes are considered. It is pointed out that more information on metagalactic cosmic rays may be gained by studying the isotropic gamma-ray spectrum between 1 and 100 MeV than by studying gamma rays >100 MeV. If π-meson production is the dominant source of metagalactic gamma rays in the 1- to 100-MeV energy range, a study of these gamma rays may provide important information on cosmology and the origin of cosmic-ray sources. (UK)

3314 RADIATION PROBLEMS: THE SPECTRUM INVOLVED. Wheatley, B. M. (Berkeley Nuclear Labs., Eng.). Ann. Occup. Hyg., 11: 329-36(Oct. 1968).

A brief review is given of the radiation spectra within and above the atmosphere. The total power involved is about 10^{21} MW with an energy density in outer space of 1 eV/cm^3. In interplanetary space the flux density is almost constant at about 2 particles/cm^2/sec. The changes in the spectrum of galactic radiation as it interacts with the atmosphere are described, and it is noted that its associated radiation dose rates are acceptably low except in isolated regions. The spectra in the Van Allen belts of geomagnetically trapped radiation are described, and the dependence of the outer belt on sunspot activity is noted. The effects of plasma and high-energy proton streams from the Sun are indicated, since they can cause high dose rates in supersonic aircraft and give rise to proton storms in interplanetary space. (auth) (UK)

Direct Energy Conversion

3315 (NP-17597, pp 75-82) GENERAL TECHNOLOGICAL STUDIES. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

DIRECT ENERGY CONVERSION DEVICES, MAGNETOHYDRODYNAMICS, THERMIONIC CELLS, DESALTING — research on, 1967 summary of French

FRANCE — research activities on desalting and direct energy conversion, 1967 summary of (H.D.R.)

3316 MAGNETOHYDRODYNAMIC ENERGY CONVERSION. Rosa, Richard J. New York, McGraw-Hill Book Company, 1968. 244p. $17.50.

The basic principles and practical aspects of MHD power generation are presented. The chapters include comprehensive discussions on the following: (1) ionization and conductivity, (2) fluid mechanics, (3) Hall and ion slip effects, engineering consequences, (4) nonequilibrium ionization, (5) magnet design, (6) miscellaneous design considerations, and (7) applications. (M.O.W.)

3317 ENERGY CONVERTER. Chapman, Richard A.; Connelly, John J. Jr. (to Texas Instruments Inc.). U. S. Patent 3,402,074. Sept. 17, 1968. Filed Mar. 22, 1963.

A collector is designed for a thermionic converter of the type having an emitter and a collector with cesium vapor disposed in the closed space between the emitter and the collector. The collector consists essentially of an electrically conductive substrate chemically stable at high temperatures, coated with a composition of cesium and an element selected from the group consisting of silicon and germanium, and containing a donor impurity from Group I-A of the periodic table in an amount sufficient to lower the thermionic work function of said composition. (auth)

3318 LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATORS. (to United States Atomic Energy Commission). British Patent 1,131,584. Oct. 23, 1968. Priority date Dec. 3, 1965, United States.

The design of a two-phase, liquid-metal MHD generator for thermal-electric power conversion is described. This generator comprises an elongated duct with a flat plate as one side and means for establishing a magnetic field through this duct. Means are included for directing a partially vaporized liquid metal onto said flat plate at an angle of between 3 and 12° causing a thin film of liquid metal to flow rapidly along the plate. Means are provided for collecting the electric current generated thereby. (M.H.R.)

3319 MAGNETOHYDRODYNAMIC ENERGY CONVERSION APPARATUS. (to Compagnie Electro-Mecanique). British Patent 1,133,381. Nov. 13, 1968. Priority date Jan. 29, 1965, France.

An MHD energy conversion apparatus is described which comprises means for generating a transverse magnetic field in at least part of which is disposed a flow path for a fluid including an electrically conductive liquid. This flow path comprises at least one closed loop. The loop or each loop includes in series and in the order stated gas dispersion means for dispersing a gas in the fluid in the loop, an energy conversion region where the resulting complex fluid is to generate or receive electrical energy, and separator means for separating gas from the complex fluid. The flow path is disposed in relation to the field generating means so that, in operation, the main flow of electrically conductive means does not enter or leave the magnetic field. The arrangement is such as to avoid or keep to a low-level parasitic flow of electrical current within said fluid in operation. (M.H.R.)

Fluid Physics

3320 A GENERAL THEORY OF THIN AIRFOILS IN NON-EQUILIBRIUM MAGNETOGASDYNAMICS. PART II. TRANSVERSE MAGNETIC FIELD. Bhutani, Om Prakash; Nanda, Kul Deepak (Indian Inst. of Tech., New Delhi). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2122-4(Nov. 1968).

Using the approximations of linearized analysis, a general theory has been developed to study the effects of relaxing state of the gas past thin airfoils. The gas under examination is assumed to be a perfect electrical conductor and to be subjected to a transverse magnetic field. In particular, the evaluation of the components of perturbed velocity and magnetic field vectors, and the pressure jump across the airfoil, has been reduced to an integral equation. (auth)

3321 EFFECT OF THE FLOW OF A CONDUCTING FLUID ON THE MAGNETIC FIELD OF A DIPOLE PLACED IN THE CENTER OF A SPHERE. Bois, Pierre-Antoine (Laboratoire de mecanique Theorique, Paris). Compt. Rend., Ser. A and B, 267: 403-5(Sept. 9, 1968). (In French).

The effect of the stationary flow with revolution symmetry of a perfectly incompressible electrically conducting fluid around a sphere in the center of which is a magnetic dipole with axis parallel to that of the flow was studied. When the Reynolds magnetic number is small, the perturbed magnetic field is calculated to the third order. An application is made to the calculation of the track on the sphere. (tr-auth)

3322 TWO-DIMENSIONAL STEADY MHD JET UNDER THE INFLUENCE OF THERMAL RADIATION. Niimi, Hideyuki; Torii, Hiromasa (Kyoto Univ.). J. Phys. Soc. Jap., 25: 1174-8(Oct. 1968).

A two-dimensional steady MHD jet of a radiating perfectly conducting perfect gas confined by the vacuum magnetic field in a space between parallel flat walls is investigated. The walls are assumed to be perfectly conducting and to have a temperature different from that of the jet. Quasi-one-dimensional approximations are made to obtain the distributions of the physical quantities along the axis of the jet. Especially, the shape of the jet is discussed in detail, and the existence of three types of flow, including the choking phenomenon, is determined. (auth)

3323 HYDROMAGNETIC STABILITY OF FREE FLOWS AT LARGE REYNOLDS NUMBERS. I. FREE BOUNDARY LAYER BETWEEN TWO UNIFORM STREAMS. Gotoh, Kanefusa (Kyoto Univ.). J. Phys. Soc. Jap., 25: 1178-85(Oct. 1968).

The stability of a free boundary layer in the presence of an aligned uniform magnetic field is investigated at large values of the Reynolds number R. The wave number α and the phase velocity c_r of the neutral disturbances are calculated as functions of the Alfvén number A and the magnetic Prandtl number γ. It is found for the case $\gamma > O(1)$ that $c_r = 0$, α is independent of γ and the critical Alfvén number is 1. (auth)

3324 EVOLUTION OF MAGNETOHYDRODYNAMIC EQUATIONS CONSIDERING THE HALL EFFECT. Brushlinskii, K. V.; Morozov, A. I. Prikl. Mat. Mekh., 32: 957-9(Sept.-Oct. 1968). (In Russian).

It was established that a magnetohydrodynamic system of equations taking into account the Hall effect for a two-dimensional plane flow of nondissipative plasma across a magnetic field is not an evolutionary (or correct) one; i.e., the Cauchy solution for high-frequency fast-growing perturbations does not hold in the case examined. A mathematical analysis was made of nonviscous, nonconducting plasma flow, considering the Hall effect. (R.V.J.)

3325 RESISTIVE-WALL EGD CHANNEL. Collier, Edward L.; Gourdine, Meredith C. (Gourdine Systems Inc., Livingston, N. J.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2278-81(Dec. 1968).

A technique is discussed which eliminates the problem of charge accumulation on dielectric EGD channel walls. A resistive leak path is provided. Use of this technique results in higher voltages, higher short-circuit currents, and a smoother output. Equations are derived which define the system electrically. Experimental data are compared to the theory and found to agree within 10%. Results of the analysis show that the resistive-wall channel may be compared to a high-internal-impedance generator. This is substantiated by the data; peak power occurred when the load resistance and internal resistance were equal, and the current–voltage characteristics were found to be essentially linear. (auth)

3326 FLOW OF A CONDUCTING FLUID IN AN EQUILATERAL TRIANGULAR CHANNEL CROSS SECTION IN PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Hirsch, Ch. (Univ., Brussels). Bull. Cl. Sci., Acad. Roy. Belg. (5), 54: 334-56(1968). (In French).

An exact solution is presented for the differential equations of magnetohydrodynamics for a laminar steady-state flow of a conducting, viscous, and incompressible fluid in a cylindrical channel of triangular cross section (equilateral triangle) in the presence of a transverse magnetic field, this being respectively parallel and perpendicular to one of the walls of the triangle; the walls are nonconducting. These solutions are obtained by a series development of eigenfunctions of the Helmholtz equation; these functions are nullified on the walls of an equilateral triangle. (tr-auth)

Geophysics

Refer also to abstracts 2474, 3228, and 3314.

3327 (AD–669805) A PROPOSED INDEX FOR MEASURING IONOSPHERIC SCINTILLATION. Environmental Research Papers No. 284. Whitney, Herbert E.; Malik, Chester (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Mar. 1968. 22p. (AFCRL–68-0138). CFSTI.

Signals from radio star sources and satellites are regularly used for studying ionospheric irregularities. Amplitude and phase deviations can be imposed on the signals from these sources as they traverse the ionosphere. A parameter frequently used to describe the magnitude of this scintillation effect is scintillation index. An experiment was designed to correlate various methods of making scintillation measurements; observations were made at 40 MHz using the ionospheric beacon, S-66. It is shown that when the law of the receiver detector is known, a conversion method allows comparison of data and statistics on scintillation index. A simplified method of scaling scintillation index is described. The accuracy of the simplified method is determined by a comparison with measurements of scintillation index by machine computation. (auth) (USGRDR)

3328 (AD–670185) STUDIES OF SPATIAL IRREGULARITIES IN THE IONOSPHERE AND THEIR VARIATIONS WITH TIME. Final Report, May 1, 1964–August 31, 1967. Morgan, Millett G. (Dartmouth Coll., Hanover, N. H. Thayer School of Engineering). Feb. 28, 1968. Contract AF19(628)-4059. 39p. (AFCRL–68-0125). CFSTI.

The AFCRL airborne ionosonde program, and the completion of development and construction of equipment for the production of oblique-path ionograms for studying traveling ionospheric disturbances are described. This equipment was installed and operated in a three-station network based at Hanover, N. H., and the analysis of observations made with the network is described. A comparison of the observations with simultaneous observations on a three-frequency, PPI display, backscatter sounder, also located at Hanover, N. H., is also described. The development of a new vertical-incidence, sweep-frequency ionosonde capable of continuous, unattended operation is reported. (auth) (USGRDR)

3329 (AD–671303) SOME RELATIONSHIPS BETWEEN AURORA AND NATURAL VLF AND LF NOISE AT PLATEAU STATION, ANTARCTICA. Report No. Scientific-1. Flint, Robert B. Jr. (Stanford Univ., Calif. Stanford Electronics Labs.). Feb. 1968. 52p. (SU-SEL–68-016). CFSTI.

Various relationships between aurora as observed in all-sky photographs and natural noise at frequencies of 1.5, 8, 50, and 110 kHz are found from data taken at Plateau Station, Antarctica, during the austral winter of 1966. The investigation was carried out in two parts: diurnal variations in occurrence were found for aurora and noise, and a minute-by-minute examination of relationships was made for a one-week period. Diurnal occurrence of noise at 110-kHz peaks before magnetic midnight at about the same time as a peak occurs in the more familiar diurnal curves of occurrence of noise at 8 kHz and of aurora. Examples are shown of several events in which associations between variations in noise and variations in auroral elevation, intensity, form, and rate of change can be found from detailed comparison of the data. The majority of all noise changes during the week was found to coincide with changes in the aurora. (auth) (USGRDR)

3330 (AD–671608) USE OF IONIC MOBILITIES FOR MEASUREMENTS IN THE LOWER IONOSPHERE. Keller, George E. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). May 1968. 21p. (BRL–1398). CFSTI.

The results of recent laboratory investigations indicate that attempts to use ionic mobilities for the identification of positive ions in the lower ionosphere must necessarily fail. A mobility determination requires ion–molecule collisions; chemical reactions occurring during these collisions will cause each mobility spectrum to tend toward a continuum. Because these reactions do not change the total number density of ion, conductivity measurements can be made using an average mobility for ions in air. (auth) (USGRDR)

3331 (CONF-670631-(Vol.1)) CONJUGATE POINT SYMPOSIUM, JUNE 13–16, 1967, BOULDER, COLORADO. (High Altitude Observatory, Boulder, Colo. Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.). July 1967. 320p.

The symposium concerned upper atmospheric phenomena whose manifestations uniquely identify pairs of northern and southern hemisphere locations at the Earth's surface which are connected by the Earth's field lines. Papers in volume one cover luminosity and ionospheric and particle precipitation. (W.D.M.)

3332 (CONF-670631-(Vol.2)) CONJUGATE POINT SYMPOSIUM, JUNE 13–16, 1967, BOULDER, COLORADO. (High Altitude Observatory, Boulder, Colo. Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.). July 1967. 250p.

Papers included in this volume cover electromagnetic and hydromagnetic guided waves. (W.D.M.)

3333 (CONF-670631-(Vol.3)) CONJUGATE POINT SYMPOSIUM, JUNE 13–16, 1967, BOULDER, COLORADO. (High Altitude Observatory, Boulder, Colo. Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo.). July 1967. 105p.

Papers included in this volume cover the aspects concerned with the geomagnetic field and magnetosphere. (W.D.M.)

3334 (IAE–1493) SIMULATION OF INTERACTION BETWEEN SUN-GENERATED PLASMA WIND AND THE MAGNETIC FIELD OF THE EARTH. Managadze, G. G.; Podgornyi, I. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1967. 12p. (In Russian). Dep.

The possibility of simulating the interaction between Sun-generated plasma wind and the magnetic field of the earth is considered. The precise simulation of all processes in the magnetosphere is practically impossible. There is, however, a possibility of selecting the experimental parameters in order to reproduce, in the laboratory, the most interesting cosmic phenomena. As an example of the correctness of limited simulation, the results of the experiments on the formation of a neutral layer are given. (JPRS)

3335 (N–68-25676) RECENT OBSERVATIONS OF LOW-ENERGY CHARGED PARTICLES IN THE EARTH'S MAGNETOSPHERE. Frank, L. A. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). July 1967. Contract NAS5-2054. 50p. (NASA-CR–88242). CFSTI.

Several recent observations of low-energy proton and electron intensities within the energy range ≈100 eV to 50 keV in the radiation zones with a sensitive array of electrostatic analyzers borne on the earth-satellite OGO 3 during mid-1966 are summarized. Measurements of charged particles of the extraterrestrial ring current during a moderate geomagnetic storm, of the low-energy proton and electron distributions in the vicinity of the midnight "trapping boundary" near the magnetic equatorial plane, and of upper limits for proton and ion (100 eV ≤ E/Q ≤ 50 keV) energy fluxes deep within the inner radiation zone are presented, together with several introductory comments concerning the morphology of the omnidirectional intensities of energetic electrons (E ≥ 40 keV, ≥ 230 keV, and ≥ 1.6 MeV) at the magnetic equator in the outer radiation zone. (auth) (STAR)

3336 (N–68-27562) A SEARCH FOR HELIUM EMISSIONS IN THE AURORAL ZONE. Eather, R. H. (Rice Univ., Houston,

Tex. Dept. of Space Science). [1967]. 14p. (NASA-CR-85657; CONF-670729-2). CFSTI.

From IQSY/COSPAR Symposium, London, England.

A photometric scanning with a sensitivity of 1R to detect any λ5876 He I emission in the auroral zone was conducted. An emission feature in this region was found to be part of the 8-2 hydroxyl system. Upper limits of 0.02 to 0.003 are placed on the λ5876/Hβ ratio and the corresponding α-particle/proton ratios are calculated as functions of particle energy. (auth) (STAR)

3337 (N-68-28765) ENERGETIC PARTICLES IN THE OUTER MAGNETOSPHERE: EXPLORER 33. Haskell, G. P. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Mar. 1968. Contract NAS5-9076. 61p. (NASA-CR-95484). CFSTI.

The fluxes of energetic particles (electrons, $E \geq 45$ keV; protons, $E \geq 730$ keV) seen between about 5 and 20 R_E by Explorer 33 are examined. It is shown that most of the features seen in the time profiles of the flux can be attributed to a single, spatially continuous central body of trapped particles whose boundary is everywhere oscillating in position. Even very strong variations in the flux, including "detached spikes" at the sunward boundary, can be attributed to these oscillations. The flux in the outer regions of this body is usually anisotropic. On the day side the flux is peaked at right angles to the local magnetic field whereas on the night side it is peaked along the field. Two exceptions to this rule were found. These observations are compared with previous ones and are discussed in the light of current theory. (auth) (STAR)

3338 (N-68-29076) NIGHTTIME BEHAVIOR OF THE F-REGION OF THE IONOSPHERE. Nisbet, John S.; Warner, R. D. (Pennsylvania State Univ., University Park. Dept. of Electrical Engineering). July 15, 1968. 104p. (NASA-CR-95737; SR-19). CFSTI.

The behavior of the F region at night was studied using the incoherent scatter sounder at the Arecibo Ionospheric Observatory to determine compatibility with current laboratory reaction rates. It was found that if currently accepted values for the ratios of the atom–ion interchange reactions between atomic oxygen and molecular nitrogen and molecular oxygen are employed with the CIRA 1965 model atmosphere, then a production source of the order of 10^9 electrons cm^{-2} sec^{-1} would be required. Such ratios are difficult to reconcile with available production mechanisms. The behavior was examined with either the neutral molecular densities or the reaction rates lowered by a factor of 3. There is considerable detailed agreement between the calculated loss rates and the observed recombination rates. Additional production sources of the order of 10^9 cm^{-2} sec^{-1} are then required after sunset and before dawn. Photoelectron fluxes, horizontal ion velocities combined with horizontal density gradients, and horizontal velocity gradients are examined as possible production sources. (auth) (STAR)

3339 ENERGETICS OF GEOMAGNETIC STORMS. Cole, K. D. (La Trobe Univ., Victoria). Aust. Phys., 5: 127-32 (Sept. 1968).

A lecture is presented on the energetics of geomagnetic storms in terms of aurorae, plasma emission from the Sun, radiation belts, and ionospheric effects. (W.D.M.)

3340 IONOSPHERIC CURRENT SYSTEMS FOR SOME INTERNATIONAL QUIET DAYS. Rudneva, N. M.; Zhumabaev, B. T. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 231-3(1968).

Translated from Geomagn. Aeron., 8: 292-5(1968).

Ionospheric current systems are plotted for very quiet and weakly disturbed international quiet days on the basis of data of northern hemisphere observatories, including observatories in the polar regions. The current systems were found to be complex and to vary from day to day. The currents in polar regions affect the currents at middle latitudes. (auth)

3341 SPACE-TIME VARIATION OF RADIO-WAVE ABSORPTION IN THE IONOSPHERE. Belkina, L. M. (Ionospheric Section, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 244-7(1968).

Translated from Geomagn. Aeron., 8: 309-13(1968).

The results are reported of an analysis of the data of the global network of stations on the noon absorption of radio waves in the ionosphere as measured by vertical pulse sounding at a frequency of ~2.0 MHz. The data refer to the period from July 1957 to December 1965. Empirical relationships are obtained between noon absorption and geographic and geomagnetic latitudes for various seasons and solar activities. (auth)

3342 TOPOLOGY OF THE HIGH-LATITUDE NIGHTTIME MAGNETOSPHERE. Eroshenko, E. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 161-5(1968).

Translated from Geomagn. Aeron., 8: 201-7(1968).

The results of magnetic measurements on Elektron 2 are examined. The space and time variability of the components of the disturbance field are determined. The largest component of the disturbance field is the antisolar component. A correspondence between the increase of this component and the growth of D_{st} variation is established. It is found that the lines of force elongate markedly in the geomagnetic tail in the high-latitude region of the nighttime magnetosphere at a distance of ~ 9 to 11 R_E. (auth)

3343 CHARACTERISTICS OF THE NEUTRAL AND IONIZED COMPONENTS OF THE ATMOSPHERE AT HEIGHTS OF 100 TO 500 KM, MEASURED DURING THE FLIGHTS OF GEOPHYSICAL ROCKETS. Gringauz, K. I.; Gdalevich, G. L.; Rudakov, V. A.; Shyutte, N. M. (Radio Engineering Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 178-82(1968).

Translated from Geomagn. Aeron., 8: 224-9(1968).

The results of simultaneous measurements of the concentration and temperature of electrons and of the absorption of solar ultraviolet radiation are compared. The profiles of electron concentration and temperature and of the solar radiation fluxes in three spectral ranges are presented. The ionization rates, the effective recombination coefficient, and the thermal flux toward the electron gas are estimated. (auth)

3344 DIURNAL VARIATIONS OF THE NATURAL FREQUENCIES OF THE EARTH-IONOSPHERE RESONATOR IN RELATION TO THE ECCENTRICITY OF THE GEOMAGNETIC FIELD. Bliokh, P. V.; Nikolaenko, A. P.; Filippov, Yu. F. (Inst. of Radio Physics and Electronics, Kiev). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 198-206(1968).

Translated from Geomagn. Aeron., 8: 250-60(1968).

The natural frequencies of the Earth–ionosphere resonator are computed with allowance for the eccentricity of the geomagnetic field and for the asymmetry of the ionosphere in the daytime and nighttime hemispheres. It is shown that the average frequency of the triplet into which the first resonance level splits varies in the course of the day. The total variation of the frequency of the fundamental oscillation ($f_1 \sim 8$ Hz) is about 0.5 Hz. (auth)

3345 SPREAD AND OBLIQUE REFLECTIONS FROM THE F-REGION. Korinevskaya, N. A. (Ionospheric Section, Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 271-4(1968).

Translated from Geomagn. Aeron., 8: 340-2(1968).

The available data on spread F for 1958–1966 collected at Alma-Ata, located in the zone of least spread-F occurrence, was systematized. In addition, oblique reflections having similar features in diurnal and seasonal variations were analyzed. The observations were made on a 15-min schedule with an AIS ionosonde. (W.D.M.)

3346 PLANETARY DISTRIBUTION OF DRIFTS IN THE F_2 REGION OF THE IONOSPHERE, EXCITED BY NEUTRAL GAS MOTIONS. Muradov, A.; Fatkullin, M. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 207-11(1968).

Translated from Geomagn. Aeron., 8: 261-7(1968).

The global distribution of plasma excited by neutral gas movements in the F2 region of the ionosphere is computed. Good agreement is found between the speed and direction of the computed plasma drifts in the F2 region and experimental measurements. The influence of these plasma drifts on the distribution of electron concentration in the F2 region is discussed qualitatively. (auth)

3347 SOME PATTERNS IN THE COEFFICIENTS OF VARIATION AND MEAN SQUARE DEVIATIONS OF CRITICAL FREQUENCIES OF THE F2 LAYER OF THE IONOSPHERE. Rodionov, Ya. S.; Gubenko, V. S. Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 212-16(1968).

Translated from Geomagn. Aeron., 8: 268-73(1968).

The presence of reliable and substantial changes in the coefficients of variation of critical F2 layer frequencies is demonstrated. Maps of mean square deviations are presented in the coordinates geomagnetic latitude and smoothed average monthly relative sunspot number. These maps are analyzed for 00, 06, 12, and 18h LT in March, June, and December, for relative sunspot numbers 0 to 170, and for geomagnetic latitudes of 30 to 60°N. (auth)

3348 SOME CHARACTERISTICS OF THE EQUATORIAL ANOMALY IN THE F2 REGION OF THE IONOSPHERE AT LOCAL NOON DURING THE IGY AND IQSY. Fatkullin, M. N. (Inst. of Terrestrial Magnetism, Ionsophere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 217-22(1968).

Translated from Geomagn. Aeron., 8: 274-81(1968).

Use is made of median f_0F2 values at stations located at latitudes $\varphi \leq \pm 40°$ during the IGY and IQSY. The position of the center of the equatorial trough in the latitudinal distribution of ionization of this region, or of the effective equator of the F2 region of the ionosphere, is analyzed in detail. Regular seasonal variations of the center of the trough, particularly during years of maximum solar activity, are established for some longitudinal sectors. The problem of the coincidence of the equator of the F2 region with the geomagnetic equator or with the equators of magnetic inclination at the Earth's surface and at a height of 300 km is investigated. The absence of an equatorial anomaly in the F2 region of the ionosphere at noon in December 1957 is indicated. (auth)

3349 SIMULATION OF F2 LAYER DISTURBANCE ON ELECTRONIC COMPUTERS. Rodionov, Ya. S.; Gubenko, V. S.; Cherkunov, A. I. Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 223-6 (1968).

Translated from Geomagn. Aeron., 8: 282-6(1968).

It is shown that a change in the coefficient of variation of critical F2 layer frequencies in the course of a day can also occur for a stationary primary ionization flux. The conclusion is reached that the disturbance criterion should be normalized according to the mean square deviation. (auth)

3350 POSSIBLE EXCITATION MECHANISM OF TYPE Pi2 GEOMAGNETIC FIELD PULSATIONS. Raspopov, O. M. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 257-60(1968).

Translated from Geomagn. Aeron., 8: 325-9(1968).

The possibility of explaining the excitation mechanism of Pi2 pulsations by the resonance of Alfvén waves in the magnetosphere cavity directly adjoining the beginning of the neutral sheet is demonstrated on the basis of an analysis of the topology of the geomagnetic field on the night side of the magnetosphere, and also of experimental data. The mechanism in question explains several characteristics of the behavior of Pi2 pulsations. (auth)

3351 HIGH-FREQUENCY INSTABILITY OF THE RADIATION BELTS OF EARTH, ASSOCIATED WITH THE LOSS CONE. Trakhtengerts, V. Yu. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 263-5(1968).

Translated from Geomagn. Aeron., 8: 332-4(1968).

Kinetic instability at cyclotron harmonics associated with the loss cone is examined. It is shown that this instability appears, generally speaking, for a charged-particle density as small as desired. (W.D.M.)

3352 IONOSPHERIC EFFECT OF THE FIRST LARGE ACTIVE REGION OF THE SUN IN THE CURRENT CYCLE (MARCH 21–25, 1966). Aggarval, S.; Zevakina, R. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 227-30(1968).

Translated from Geomagn. Aeron., 8: 287-91(1968).

The disturbance of the F region at various latitudes in the eastern and western hemispheres is examined. It is found that a corpuscular stream has a different effect on the day and night ionosphere, particularly during the first day of a disturbance. The f_0F2 were enhanced on the day side and depressed on the night side. The increase in ionization was accompanied by a slight upward shift of the region and the ionization decrease, by substantial broadening. (auth)

3353 IONIZATION DRIFT IN THE AURORAL ZONE F-REGION DURING MAGNETIC DISTURBANCES. Mizun, Yu. G. (Polar Geophysical Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 274-6(1968).

Translated from Geomagn. Aeron., 8: 343-4(1968).

Formulas are given for estimating the change of the electron profile in the auroral zone during a negative magnetic bay. (W.D.M.)

3354 EFFECTS OBSERVED IN THE F2 LAYER OF THE IONOSPHERE FOLLOWING AN SSC MAGNETIC STORM. Krutikova, T. I.; Fatkullin, M. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 276-8(1968).

Translated from Geomagn. Aeron., 8: 345-7(1968).

Information is given on effects in the F2 layer, associated with an SSC in the magnetic field, according to stations located on the night and day sides of the Earth. The analysis was made on the basis of critical F2-layer frequencies. Use was made of the results of observations on a 15-min schedule. (W.D.M.)

3355 VARIATIONS IN IONOSPHERIC PARAMETERS DURING THE EFFECT OF AN SC AS A FUNCTION OF SOLAR AND MAGNETIC ACTIVITY, ACCORDING TO THE DATA FROM LINDAU. Shashun'kina, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 283-4(1968).

Translated from Geomagn. Aeron., 8: 352-4(1968).

The ionospheric effects of the sudden commencement of a magnetic storm during two separate storms in periods of very high (1959) and very low (1965) activity were investigated by Shashun'kina (1966) (1968). The results of a study of the ionospheric effect after an SC, based on observations at Lindau, are reported for 50 storms spanning half of a solar cycle (1957–1965). (W.D.M.)

3356 METHOD OF DETERMINING ELECTRON CONCENTRATION IN THE LOWER IONOSPHERE. Pavlov, A. F. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 285-6(1968).

Translated from Geomagn. Aeron., 8: 355-6(1968).

A method of determining electron concentration in the lower ionosphere is proposed, which is based on the measurement of the Faraday rotation of the polarization plane of radio waves scattered by a meteor trail. The main advantage of this method is the use of relatively high frequencies (30 to 70 MHz), higher than collision and gyromagnetic frequencies. This simplifies the interpretation of experimental data. (W.D.M.)

3357 COMPUTATION OF ELECTRON CONCENTRATION PROFILES AS A METHOD OF OBTAINING INFORMATION ON E_s. Chavdarov, S. S.; Chernysheva, S. P.; Ryss, I. K. (Rostov State Univ., Rostov-on-Don, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 287-9(1968).

Translated from Geomagn. Aeron., 8: 357-8(1968).

Using a method of Danilkin and Zhuchenko (1964), the variations of electron concentration in the F region were computed for specific cases and the median value at fixed heights for a given month was then determined. In most cases the appearance of an E_s layer was associated with a change in electron concentration in the F region, and the change in electron concentration was different at various levels of the region. The change in electron concentration was more pronounced in the lower part of the region, while in the upper levels this change was either small or not revealed. (W.D.M.)

3358 POSSIBLE APPLICATION OF CORRELATION METHODS TO E_s ANALYSIS. Mal'tseva, O. A.; Chernysheva, S. P. (Rostov State Univ., Rostov-on-Don, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 289-90(1968).

Translated from Geomagn. Aeron., 8: 359-60(1968).

The dependence of E_s parameters on solar activity has been demonstrated previously. However, this dependence is not explicit, since the variations in E_s parameters depend on the simultaneous effect of many factors. To determine the relationship between the probability of E_s appearance, $(pE_s)_{\tau<\tau_0}$, the stability of reflections from $E_s(\theta)$, and sunspot numbers, use was made of correlation coefficients for the seasonal and long-period variations of the selected parameters at definite hours of the day and then averaged over 24 hours. (W.D.M.)

3359 TRAVELING DISTURBANCES IN THE IONOSPHERE. Krylova, V. S.; Odintsova, I. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 291-4(1968).

Translated from Geomagn. Aeron., 8: 361-4(1968).

Stratifications appearing at various heights in the ionosphere and traveling both toward the low- and high-frequency ends of ionograms were examined. As experimental material, use was made of 5-min and continuous ionograms obtained in Moscow during regular international days and special intervals from 1959 to 1963. In all, 72 days were examined. Stratifications were revealed on only 22 of these days and the disturbance sometimes appeared and disappeared periodically in the course of the day. A total of about 150 traveling disturbances were examined. It was found that traveling disturbances can appear not only in the vicinity of critical F2-layer frequencies but also at F1-layer frequencies, and then move gradually toward the low-frequency end of ionograms. (W.D.M.)

3360 DETERMINATION OF THE EXTREME LEVELS OF THE rn(r) FUNCTION AND MUF UNDER VARIOUS IONOSPHERIC CONDITIONS. Shlionskii, Sh. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 295-7(1968).

Translated from Geomagn. Aeron., 8: 367(1968).

A dependence of the extreme n_A level, where rn(r) is a minimum (r is the geocentric distance and n is the index of refraction) on the layer parameters and operating frequency was obtained by the author previously (1965). This dependence is used for further analysis. The lowermost boundary of the reversal points of rays reflected in the ionosphere and directed downward is determined by the level $r_c \approx r_A n(r_A)$. By substituting the expression for r_A

into the formula for the index of refraction, the dependence of $r_A n(r_A)/r_{max}$ on f/f_{cr} and y_m/r_{max} was obtained and is presented graphically. (W.D.M.)

3361 INFLUENCE OF RADIO WAVE ABSORPTION IN THE IONOSPHERE ON THE VARIATION OF SPORADIC E-LAYER PARAMETERS. Chavdarov, S. S.; Chernysheva, S. P.; Svechnikov, A. M. (Rostov State Univ., Rostov-on-Don, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 294-5(1968).

Translated from Geomagn. Aeron., 8: 365-6(1968).

The presence of a clear negative correlation between solar activity and the parameters characterizing the stability of reflections from the E_s layer was noted previously. To elucidate the causes of this relationship, an attempt was made by Svechnikov et al. (1966) to compare the variations of the absorption coefficient with the coefficient of stability of reflections from E_s, but no explicit answer was obtained. However, mention was made by Kerblay et al. (1966) and Erofeev (1960) of a relationship between absorption and the cutoff frequency of reflections from E_s, (f_0E_s) and, consequently, a definite relationship with the stability of reflections from E_s had to be found also. Measurements of radio wave absorption in the ionosphere at five fixed frequencies at Rostov-on-the-Don in 1966 made it possible to examine this problem in more detail. (W.D.M.)

3362 SOLAR FLARE EFFECTS IN THE OZONOSPHERE. Steblova, R. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 299-301(1968).

Translated from Geomagn. Aeron., 8: 370-1(1968).

The results of observations show that the ozonosphere is not inert to solar activity manifestations. It is not only important that chromospheric flares are reflected in the variations of the ozonosphere, but it is also important that the effect in the ozonosphere appears much earlier than the optical phase of a chromospheric flare. (W.D.M.)

3363 SOME PROBLEMS CONCERNING AURORAL ABSORPTION. Dubatovko, O. E.; Pudovkin, M. I.; Shumilov, O. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 240-3(1968).

Translated from Geomagn. Aeron., 8: 303-8(1968).

It is shown that a systematic time lag in cosmic radio noise absorption bays in the morning–daytime hours behind absorption in the evening–night hours is observed in the auroral zone. This delay is explained by the drift of electrons trapped in the magnetosphere. The drift surface is the surface of the second invariant at a distance of $6R_E$ from the dipole in the equatorial plane. It is assumed that there is an electric field of $\sim 4 \times 10^{-5}$ V/cm at this distance in the magnetosphere. (auth)

3364 IONOSPHERIC F-REGION ACCORDING TO MEASUREMENTS OF "EXPLORER-22" RADIO SIGNALS IN AURORAL AND MIDDLE LATITUDES. Mityakov, N. A.; Mityakova, E. E.; Cherepovitskii, V. A. (Gorky Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1318-23(1968). (In Russian).

Observations of the Explorer-22 (S–66) signals made simultaneously in Gorkii (56° north latitude, 43°39′ east longitude) and in Murmansk (68°58′ north latitude, 33°03′ east longitude) in 1965–1966 are reported. The data on the electron concentration in a vertical column of the unit section and the effective thickness of the ionosphere depending on the time of day, season, and solar activity are given. The state of the auroral ionosphere is compared with that in the middle latitude. (auth)

3365 ELECTRON DENSITY IRREGULARITIES IN THE IONOSPHERE ACCORDING TO THE MEASUREMENTS OF SATELLITE SIGNALS BY THE DIFFERENTIAL DOPPLER METHOD. Mityakov, N. A.; Mityakova, E. E.; Cherepovitskii, V. A. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1324-31(1968). (In Russian).

The results of processing the fluctuations of the phase difference of "Explorer-22" coherent signals observed in Gorkii and Murmansk in 1965 are presented. A classification of irregularities is given and their main parameters are estimated. (auth)

3366 ON THE TIME OF FORMATION OF SPORADIC-E REGION. Ignat'ev, Yu. A. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1332-9(1968). (In Russian).

The equation describing the time variations of the electron density is derived on the basis of the theory of sporadic-E-region formation due to the wind drifts. The solution of the equation is found and the time of E-region formation is estimated for the case when the wind velocity reached the definite value. The E_s region is shown to be formed with the characteristic time τ of several minutes after the formation of the wind system. (auth)

3367 IONOSPHERIC DISTURBANCES DUE TO ATMOSPHERIC WAVES. Georges, Thomas Martin. Boulder, Colo., Univ. of Colorado, 1968. 157p.

Thesis.

The theoretical and experimental evidence that disturbances in the neutral atmosphere cause ionospheric traveling irregularities that affect radio propagation was investigated. Traveling disturbances are found to be divided into two distinct classes which are called "very large" and "medium scale." The very large disturbances are closely associated with magnetic storm activity, while the medium-scale disturbances are not, but still come from the polar regions. Both types are manifestations of internal atmospheric gravity waves. (TSS)

3368 SOME PROBLEMS PERTAINING TO THE MACROSCOPIC STABILITY OF THE SURFACE OF THE MAGNETOSPHERE. Buffalano, August Charles Jr. New Haven, Yale Univ., 1968. 102p.

Thesis.

In recent years, a great deal of attention has been focused on the physical phenomena associated with the interaction of the solar wind and the geomagnetic field. Satellite observations indicate that fluctuations in the solar wind caused by solar activity induce oscillations of the interaction zone causing magnetic storms and the precipitation of particles into the magnetosphere. The large-scale surface dynamics of the dayside of the magnetosphere were investigated by a theoretical study of the Chapman–Ferraro, ideal magnetohydrodynamic, and Chew–Goldberger–Low models of the interaction. The work reported is essentially a phenomenological study to determine the importance of some specific mechanisms which lead to surface instabilities. The important part which the convection of disturbances plays in controlling surface instabilities is shown and leads to the conclusion that, for the models considered at least, the possibility of large amplitude surface disturbances on the dayside of the magnetosphere appears remote. (Disser. Abstr.)

3369 RESONANT-MODE COUPLING EFFECTS IN THE EARTH–IONOSPHERE CAVITY. Large, David Brownlee. Boulder, Colo., Univ. of Colorado, 1968. 214p.

Thesis.

Various mathematical cavity models were analyzed. Two different models were used to analyze the mode coupling effects due to a dipolar, static magnetic field configuration, and the influence of TE modes is clearly illustrated. Another model was used to examine the coupling of modes of like species due to an abrupt transition between day and night ionospheric boundaries. Finally, a model with both day and night hemispheres and a dipolar static magnetic field was analyzed, and the predicted resonant characteristics were compared with a constant field model whose field strength is equal to the average of the radial component of the dipolar field model. Finally, the phenomenon of changing resonant mode frequency with source–receiver spacing is illustrated, and previously measured diurnal changes in the resonances are explained qualitatively. (TSS) (Disser. Abstr.)

3370 INTENSITY FLUCTUATIONS OF CHARGED PARTICLES MOVING IN A RANDOM MAGNETIC FIELD. Shishov, V. I. (Leningrad Inst. of Physics). Zh. Eksp. Teor. Fiz., 55: 1449-55(1968). (In Russian).

Propagation of charged particles in a random magnetic field is considered under the assumption that the characteristic size of the magnetic field inhomogeneities is much smaller than the characteristic value of the Larmor radius. An equation for the second moment of the exact distribution function characterizing the charged-particle intensity fluctuations is derived from the noncollision kinetic equation for the exact distribution function and by applying the diagram technique. The solution of the equation is obtained for weak-intensity fluctuations. It is shown that a study of intensity fluctuations yields information on the structure of random magnetic fields. (auth)

3371 RELATION BETWEEN SUNSPOT NUMBER AND THE IONOSPHERIC INDEX IF2. Muggleton, L. M.; Kouris, S. S. (Univ. of Edinburgh). Radio Sci., 3: 1109-10(Nov. 1968).

A plot of the relationship $(IF2)_{12}/R_{12}$ for each month of the period 1942 to 1967 exhibits a hysteresis characteristic in addition to a systematic change from one solar cycle to the next. A relationship based on all these data is proposed and a means is suggested of fitting this expression to the particular "half"-cycle of interest. In this way a conversion of parameter from R to IF2 may be made, with all the attendant advantages of the use of the latter index, in expressions relating R to ionospheric behavior based on the measured results of a particular period. (auth)

3372 CONSTITUTION OF POLAR MAGNETIC DISTURBANCES. Iijima, Takesi; Nagata, Takesi (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 1-24(June 1968).

According to time and space characteristics of polar magnetic storms in high latitudes, the constitution of a polar disturbance field D_p is concluded to be D_p = SP + AEJ. Here, SP is characterized by electrovortices (or an electrovortex) whose centers are in the polar region. SP includes two types of mode; one has a pattern similar to S_{sp} and the other resembles a DS mode with an enhancement of current flow along the auroral zones in the early morning and afternoon hours. The time variation in SP ranges from several minutes to a few hours (or more), the peak occurring usually around an hour. SP changes gently over the polar region. On the other hand, AEJ shows a concentrated jet current of sporadic and impulsive appearance, and flows mostly westward in a narrow latitude range along the auroral oval on the night side (it flows sometimes eastward in the auroral zone in the afternoon hours), with its countercurrents in the polar cap and the middle-low latitudes. The statistically derived, so called SD field (or average D_p) may be attributed to the superposition of both the polar electrovortices (SP) and auroral electrojets (AEJ). In a discussion of the mechanism for D_p, it is tentatively concluded that an SP-like event in the pre-bay stage may be important for the creation of an unstable situation in the outer magnetosphere, which may induce the local electric field and the bombardment of the plasma stream responsible for AEJ event. (auth)

3373 ONSET ON SEVERE AMPLITUDE SCINTILLATIONS OF SATELLITE RADIO SINGALS DURING SUNRISE. Arendt, P. R.; Soicher, H. (Army Electronics Command, Fort Monmouth, N. J.). Nature (London), 220: 459-60(Nov. 2, 1968).

The general considerations affecting ionospheric sunrise effects are outlined; these effects are likely to produce a turbulent motion within the ionosphere at points of first illumination. Observations made at equinox are described; amplitude scintillations were observed, together with changes of columnar electron content, during ionospheric sunrise, progressing from 800-km altitude downward to 100 km. The observations were made with the radio beacons of Explorers 22 and 27 during closely spaced passages. Because the event was observed at equinox conjugate heating could be neglected. Faraday plane of polarization rotation measurements were made at 20, 40, and 41 MHz, using two different methods. Amplitude and polarization analogue recordings are shown; a rather abrupt onset of severe amplitude scintillations was observed, which almost obliterated the Faraday fadings of the amplitude recording. These scintillations were preceded by rather smooth polarization variations. The numerical readout of the polarization angle at 40 MHz was converted to columnar electron content, and it was shown that the onset of amplitude scintillations preceded variations in electron content, confirming previous observations. The reported observations were made before ground sunrise, but illumination was provided by filtered sunlight. The changes in electron content below the satellite altitude of 100 km could not be interpreted by electron production, and must have been related to drifts or motions, which in turn were related to temperature effects. The onset of sunlight produced a smoothing of the turbulence. In order to substantiate the supposition that illumination of the F region and above causes fluctuations in electron content, topside sounder data taken when part of the ionosphere below the satellite changed from night to day were examined. The data, combined with the electron content measurements, indicate a mechanism which, because of the impact of sunlight at ionospheric sunrise, produces transient turbulence; the turbulence causes variations in electron content, which in turn produce amplitude scintillations. The turbulence and its side effects disappear when illumination and heating have lasted for some time. (UK)

3374 OBSERVATION OF ELECTROSTATIC RESONANCES OF THE IONOSPHERIC PLASMA. Warren, E. S.; Hagg, E. L. (Defence Research Telecommunications Establishment, Ottawa). Nature (London), 220: 466-8(Nov. 2, 1968).

It was expected that resonance phenomena would appear in a plasma irradiated with radio waves at frequencies for which the group velocity of the electrostatic waves is zero or small, and this has been used to explain some observed resonances. Bernstein's theory, however, also predicts zero group velocity at frequencies for which resonances have not been observed. Some examples of Alouette satellite signals believed to result from electrostatic resonances are shown; resonances observed by satellite instruments may correspond to a finite group velocity that matches the satellite velocity. It is thought that energy is stored in the ionospheric plasma in the form of electrostatic waves of approximately zero group velocity, producing a relatively long-enduring signal in the receiver. In order to confirm the identification of the resonances the dependence of the observed resonance frequencies on plasma parameters was compared with the theoretical dependence calculated from Bernstein's theory, together with the condition of zero or small group velocity. Experimental data are given; these agree well with theoretical predictions. (UK)

3375 THEORETICAL PREDICTION ON DISCRIMINATION OF MODIFIED AND HYBRID PLASMA RESONANCES. Oya, Hiroshi (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 22: 119-22(June 1968).

The instrumentation of the gyro-plasma probe experiment has unique points in measuring the rf admittance of the probe which is immersed in a space plasma. This probe admittance is measured in amplitude and phase shift simultaneously versus the frequency which is swept in a range including the gyro resonance, the sheath resonance. This probe has, therefore, ability to discriminate between many kinds of plasma resonance, precisely. In this note, a theoretical prediction is made for the discrimination of modified plasma resonances at a frequency near the upper hybrid resonant point. (W.D.M.)

3376 FEATURES OF MAGNETIC STORMS RELATED TO THE SOLAR-WIND STRUCTURE. Oguti, Takasi (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 37-44(June 1968).

Various features of magnetic storms during their developing and decaying stages reveal the physical structure of interplanetary space and solar-wind bubbles attacking the Earth's magnetosphere. Important factors to be considered are not only the momentum change upon impact of solar-wind bubbles with the magnetosphere but also the magnetic field contained within the bubbles and in interplanetary space. Magnetic storms can be classified into seventeen kinds, based on a qualitative relation between the physical structure of the solar wind and the magnetic-storm features resulting therefrom. (auth)

3377 HYDROMAGNETIC EMISSIONS ASSOCIATED WITH STORM SUDDEN COMMENCEMENTS. Kokubun, Susumu; Oguti, Takasi (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 45-59(June 1968).

Characteristics of hydromagnetic emissions observed at the auroral zone station, Syowa Base, Antarctica, are discussed with special emphasis on the storm sudden commencement effect. Hydromagnetic emissions are found to be most likely associated with ssc's which occur around noon, though they cannot be correlated with general geomagnetic activity. These ssc HM emissions seem to have different characteristics according to whether or not HM emissions appear within several hours before the storm sudden commencement. When the preceding emissions are present, the ssc emission shows a complicated frequency-time structure with a non-periodic sequence of rising frequencies, and the average frequency and bandwidth are greater than those of preceding emissions. On the other hand, ssc HM emissions occurring without preceding emissions show a burst-like trace on the record. Examination of hydromagnetic emissions and also of vlf emissions at times of storm sudden commencements will provide useful information on the generation of these emissions in the magnetosphere. (auth)

3378 EFFECT ON THE GEOMAGNETIC FIELD OF THE SOLAR ECLIPSE OF NOV. 12, 1966 AT AND NEAR THE DIP EQUATOR. Giesecke, Alberto A. (Instituto Geofisico del Peru, Huancayo); Casaverde, Mateo; Kato, Yoshio; Aoyama, Iwao; Takei, Shigeo. Rep. Ionosphere Space Res. Jap., 22: 61-9(June 1968).

Observations of the geomagnetic field were carried out at the Huancayo Observatory, Peru, and five other temporary stations near the dip equator to investigate the effect on the geomagnetic field of the total solar eclipse of Nov. 12, 1966. A very distinct eclipse effect on the geomagnetic field was observed in the vicinity of the equatorial electrojet. The maximum decrease in the horizontal component of the geomagnetic field due to the eclipse effect at Huancayo near the dip equator was about 50% of the usual daily variation at that time. (auth)

3379 CHANGES IN THE CONDUCTIVITY OF THE IONOSPHERE AT AND NEAR THE DIP EQUATOR DURING THE SOLAR ECLIPSE OF NOVEMBER 12, 1966. Kato, Yoshio; Mori, Yohsuke (Tohoku Univ., Sendai). Rep. Ionosphere Space Res. Jap., 22: 71-88(June 1968).

An eclipse effect on the geomagnetic field at and near the geomagnetic equator was very clearly observed at six stations near the path of totality of the solar eclipse of Nov. 12, 1966, at and near Huancayo, Peru. It is shown that the magnetic effect takes place in the N–S and vertical components only at these stations, and the distribution of changes show such a distinct character that the farther the observation from the geomagnetic equator, the more asymmetric the decrease in the N–S component before and

after the time of maximum eclipse, and the more noticeable the accompanying decrease in the vertical component. The changes in the electrical conductivity were calculated, integrated over the layer, using the electron density distribution obtained from the data for foE at Huancayo at the time of the solar eclipse. The "additional current system" which is responsible for the modification of the magnetic field by the solar eclipse is discussed. It is concluded that the observed distinct change in the geomagnetic field mentioned above is due to the fact that the path of the center of the "additional current system" does not coincide with the path of the total eclipse because of the existence of an equatorial electrojet near the path of total eclipse. (auth)

3380 MAGNETIC FIELD OSCILLATIONS NEAR THE EARTH'S BOW SHOCK FRONT. Araki, Tohru (Kyoto Univ.); Namikawa, Tomikazu. Rep. Ionosphere Space Res. Jap., 22: 89-105(June 1968).

Numerical calculations were carried out to obtain oscillatory solutions of a system of nonlinear differential equations which determine the steady states on both sides of a hydromagnetic shock front. Wavelengths and maximum amplitudes of the oscillations were calculated versus the Alfvén Mach number. Results are in agreement with circularly polarized magnetic oscillations with frequencies of about 1 cps observed by the OGO-A satellite on both sides of the Earth's bow shock front. (auth)

3381 CALCULATIONS OF DIURNAL CHANGES IN THE EXOSPHERE. Titheridge, J. E. (Univ. of Auckland, New Zealand). J. Atmos. Terrest. Phys., 80: 1843-56(Nov. 1968).

Explorer 22 measurements of the electron density and temperature at a height of 1000 km at night were used to calculate the total electron content of the tubes of force at different latitudes. The results agree with whistler measurements if the ion composition changes from at least 50% H^+ at latitudes below 30° to about 5% H^+ at latitudes above 60°. The tube content is then approximately constant at 10^{17} electrons/m^2 between latitudes of 30 and 50°, with a rapid decrease at lower latitudes and a rapid increase at higher latitudes. Diurnal changes were calculated assuming that there is no change in the total proton content of a tube of force. Diurnal changes in the ionosphere then produce a variation in the O^+ to H^+ transition level, at medium latitudes, from 500 km at night to 1000 km during the day. This agrees with recent observations. The calculated diurnal change in the density above the equator is consistent with whistler results. The diurnal change at 1000 km disappears at latitudes between 20 and 50°, agreeing with Explorer 22 and Alouette 1 observations. There is a downwards flow of ionization at night, of an amount almost sufficient to maintain the night ionosphere at latitudes between 20 and 45°. (auth) (UK)

3382 MAINTENANCE OF THE NIGHT IONOSPHERE. Titheridge, J. E. (Univ. of Auckland, New Zealand). J. Atmos. Terrest. Phys., 30: 1857-75(Nov. 1968).

The electron content of the ionosphere was recorded continuously at latitudes of 34°S and 42°S for a period of 18 months. The results were combined with ionosonde measurements to determine the mean changes in the nighttime ionosphere at latitudes of 10 to 60°. The effective loss coefficient β was constant at about 4×10^{-5} sec^{-1} in summer, and 3×10^{-5} sec^{-1} in winter, throughout most of the night. This agrees with the values observed at sunset when allowance is made for changes in the height and temperature of the F layer. A nocturnal source of ionization is observed at all seasons. It acts for about 3 hr near midnight at geomagnetic latitudes of 15 to 40° in summer and 25 to 50° in winter. The total influx is about 2×10^{16} electrons/m^2, with an annual variation of 50% and a solar-cycle variation of 150%. The influx increases by 50% during periods of high magnetic activity. Calculations of the diffusion of ionization from the exposure, assuming that there is no production or loss of protons by charge exchange, predict a nocturnal flux of 2×10^{16} electrons/m^2 into the ionosphere at latitudes between 20 and 45°. This influx will extend to higher latitudes in winter than in summer. It will have an annual variation of 50% and a solar cycle variation of about 150%. (auth) (UK)

3383 VARIATION WITH HEIGHT OF THE F-LAYER LUNAR TIDE. Brown, R. A. (London Univ.). J. Atmos. Terrest. Phys., 30: 1877-82(Nov. 1968).

It is shown that it is possible to determine the lunar tidal effect of F-layer parameters at various heights from the routine hourly readings of these parameters. A detailed account is given of an investigation of the lunar tide in f_0F2 and h_mF2 for a range of heights at Ibadan. The tide in f_0F2 is of a "standing-wave" type, with a node at a height (h_m) of 308 km. Both amplitude and phase of the h_mF2 tide vary exponentially with height. (auth) (UK)

3384 FREQUENCY DEPENDENCE OF ABNORMAL IONOSPHERIC ABSORPTION IN AURORAL ZONE. Belikovich, V. V. (Scientific-Research Radiophysics Inst., Gorky, USSR); Benediktov, E. A.; Itkina, M. A.; Petrova, G. A.; Rapoport, Z. Ts. J. Atmos. Terrest. Phys., 30: 1883-9(Nov. 1968).

The results are given of investigations of the frequency dependence $\Gamma(f)$ of the abnormal absorption of radio waves in the ionosphere. The data were obtained from observations of cosmic radio noise at 9, 13, 25, and 40 Mc during 1965–1966 at Loparskaya (near Murmansk). (auth) (UK)

3385 ON IONIZATION IN THE IONOSPHERIC D REGION BY GALACTIC AND SOLAR COSMIC RAYS. Velinov, P. (Geophysical Inst., Sofia). J. Atmos. Terrest. Phys., 30: 1891-1905 (Nov. 1968).

Electron production rate q and electron density N produced by cosmic rays in the lower part of the D region are theoretically considered. On the basis of the obtained formulas q and N are calculated from galactic cosmic rays for four geomagnetic latitudes: 0, 30, 41, and 55° at maximum and minimum solar activity in winter and summer. The ionization by solar cosmic rays is considered — the so-called polar cap absorption event. Solutions of q(h) are obtained in the cases of flat and spherical Earth, and calculations are made for clearing up the contribution of the protons, α particles, and heavy nuclei ($Z \geq 10$) in the rate of total electron production. (auth) (UK)

3386 26-MONTH PERIODICITY IN QUIET-DAY RANGE OF GEOMAGNETIC HORIZONTAL FORCE AND IN SUNSPOT NUMBER. Yacob, A.; Bhargava, B. N. (Colaba Observatory, Bombay). J. Atmos. Terrest. Phys., 30: 1907-11(Nov. 1968).

In view of conflicting and inconclusive evidence on the existence of a quasi-biennial cycle in geomagnetic field a search was made for the 26-month oscillation using an extensive series of geomagnetic data covering 61 yr from Alibag Observatory. In order to ascertain if the oscillation in geomagnetic data is of solar origin, the relative sunspot number for the same period was also analyzed. It was concluded that a 26-month oscillation of a small but significant amplitude occurs in the quiet-day range in the horizontal force of the Earth's magnetic field and appears to be of solar origin. The investigation also revealed the existence of a 16-month oscillation of unknown origin, both in the quiet-day range and in the sunspot number. (auth) (UK)

3387 SPACED RECEIVER MEASUREMENTS OF THE HEIGHT OF IONOSPHERIC IRREGULARITIES OVER EUROPE. Frihagen, J. (Norwegian Defence Research Establishment, Kjeller). J. Atmos. Terrest. Phys., 30: 1913-18(Nov. 1968).

The height of the ionospheric irregularities giving rise to satellite scintillation was measured using spaced-receiver observations from several places in Europe. The irregularities were largely found to be in the 200- to 400-km height range. (auth) (UK)

3388 MAINTENANCE OF THE TROPICAL NIGHTTIME F LAYER. Brown, W. E.; Steiger, W. R.; Roach, F. E. (Univ. of Hawaii, Honolulu). Nature (London), 220: 568-9(Nov. 9, 1968).

Observations of oxygen red line emission in the tropical night airglow, coupled with studies of the ionospheric electron content made by the Faraday rotation technique with a view to determining the proportionality constant connecting electron loss and quantum emission rates, led to the conclusion that a large nighttime source of ionization is required in the tropics. Observations in a fixed direction indicated bursts of increased intensity lasting for a few hours during the night. The results raise important questions regarding the maintenance of the nocturnal ionosphere in the tropics, and possibly also at mid-latitudes. Integration of the equation of continuity of electrons, including diffusion, recombination and drifts, indicated that the characteristic duration of an airglow enhancement is the natural transient response time of the F layer to sudden downward plasma drifts, and it seems likely that the nighttime ionization source is also associated with plasma drifts. It is postulated that the increases in electron content are due to the divergence of a horizontal ionization flux, the latter being most likely caused by electric fields associated with the Sq current system. (UK)

3389 ON THE MANIFESTATION OF THE 11-YR CYCLE OF SOLAR ACTIVITY IN THE BRIGHTNESS OF THE NIGHTGLOW. Gnevyshev, M. N. (Pulkovo Observatory, Moscow); Ohl, A. I. Planet. Space Sci., 16: 1311-12(Oct. 1968).

The monthly values of the nightglow brightness in the O I λ5577-Å line for 1957–1963, as given by Rosenberg and Zimmerman (1967), are shown. There were maxima on this curve in 1958 and 1960. The authors suggest that the first maximum was caused by ultraviolet radiation, and the second by solar corpuscles. (UK)

3390 INTERACTION OF PLASMA WAVES AND PARTICLES IN THE NON-UNIFORM MAGNETOSPHERE AND ACCELERATION

OF AURORAL PARTICLES. Hruska, A. (Univ. of British Columbia, Vancouver). Planet. Space Sci., 16: 1297-1303(Oct. 1968).

A plasma wave propagating across a field-aligned sheet with a steep density gradient is considered. The wave may be modified inside the sheet in such a way that a strong electric field appears parallel to the unperturbed magnetic field. This field component may deliver energy to "hot" particles at a rate comparable to, or even much higher than, the maximum possible rate of energy exchange between waves and particles in a uniform plasma due to the cyclotron instability mechanism. It is suggested that this energization of particles in regions of abrupt change of the plasma density (such as the plasmapause or the ducts of whistler mode waves) might be responsible for discrete spatially limited events of auroral precipitation. (auth) (UK)

3391 IONOSPHERIC ELECTRON CONTENT AND SCINTILLATION STUDIES AT WIDELY-SPACED LOW-LATITUDE STATIONS. Planet. Space Sci., 16: 1277-89(Oct. 1968).

Results of measurements of electron content, of ionospheric slab thickness and of scintillations from three low latitude stations are presented. The three stations are Nairobi (Kenya), Kingston (Jamaica), and Haifa (Israel). Measurements were made of the Faraday polarization rotation of radio signals from the ionospheric beacon satellites S-66 and Be-C during the period March–June 1965. The results show similar diurnal variations of electron content for the three stations, with a ratio of daytime maximum to predawn minimum of 8 to 10. Large variation in daytime values of electron content appear between Nairobi and Haifa, indicating large latitudinal gradients. The daytime values at Kingston and Haifa differ by about 25%. Results of slab thickness and of scintillation occurrence are similar at Haifa and Kingston, while at Nairobi the slab thickness values are lower and there is an increase in the percentage of scintillation occurrence during daytime, in comparison to the other two stations. (auth) (UK)

3392 CALCULATION OF AURORAL EMISSION RATES AND HEATING EFFECTS. Stolarski, R. S. (Univ. of Michigan, Ann Arbor). Planet. Space Sci., 16: 1265-76(Oct. 1968).

The primary electron energy spectrum in an aurora was determined by fitting the altitude profile of the 3914-Å emission. This spectrum is degraded through the atmosphere, and the secondary electron energy spectra were calculated at various altitudes. From these spectra the excitation and emission rate profiles of many important lines were calculated. These include the oxygen 5577 Å and 6300 Å lines and the N_2 1st and 2nd positive and Vegard–Kaplan bands. The heat input to the ambient electrons and the resultant electron temperature were also calculated. (auth) (UK)

3393 INTENSITY RATIO I(4278)/I(5577) IN AURORA. Brekke, A. (Auroral Observatory, Tromsoe, Norway); Omholt, A. Planet. Space Sci., 16: 1259-64(Oct. 1968).

The ratio between the intensities of the first negative N_2^+ band 4278 Å and the green oxygen line 5577 Å is shown to vary with a factor of about 3 in auroral displays. Observations in qualitative agreement with those of Romick and Belon (1967), showing a greater enhancement of the 5577 line in the center of an arc, are reported. It does not seem possible to explain the observed effect by current theories on the excitation of the auroral spectrum. (auth) (UK)

3394 BOUNDARY LAYER BETWEEN A COLD PLASMA AND A CONFINED MAGNETIC FIELD WHEN THE PLASMA IS NOT NORMALLY INCIDENT ON THE BOUNDARY. Davies, Christine M. (London Univ.). Planet. Space Sci., 16: 1249-57 (Oct. 1968).

The effect of a transverse plasma velocity component on the structure of the boundary layer between a plasma and a vacuum magnetic field is considered in greater detail than hitherto (Parker, 1967). The exact equations of the problem, taking into account the electrostatic field arising from charge separation in the boundary, are solved numerically. It is shown that the additional magnetic field, produced by the transverse velocity component, depends critically on the degree of neutralization and that this field is very small compared with the vacuum magnetic field unless the boundary layers are neutralized to a high degree by the presence of a background plasma. When the electrostatic field is completely neutralized, the magnetic field component due to the transverse component of velocity is dominant, even for comparatively low transverse velocities. Moreover, for this model, the new component of the magnetic field does not vanish at the stream front and (in the case of complete neutralization) its direction is such as to confine the plasma. The results are discussed in connection with the magnetopause. (auth) (UK)

3395 X-RAY AIRGLOW IN THE DAYTIME SKY. Grader, R. J.; Hill, R. W.; Seward, F. D. (Univ. of California, Livermore). J. Geophys. Res., 73: 7149-53(Nov. 15, 1968).

On Sept. 7, 1967, a two-stage Nike–Tomahawk rocket was launched from Tonopah. The payload carried an x-ray astronomy experiment consisting of two thin-window gas-flow proportional counters with their gas supply system and associated electronics. The experiment was to measure the soft x-ray spectra of the Crab and Sco X-1. At 100 km the scalers of both counters indicated a sudden increase in counting rate which peaked at 130 km with a counting rate of 5000 c/cm²/sec/ster. It was concluded that the photons that caused this high count rate above 100 km are the atmospheric N and O Kα lines resulting from fluorescent excitation by solar x rays. (W.D.M.)

Low-Temperature Physics

3396 (ANL-Trans-681) METHOD OF PRODUCING SUPERLOW TEMPERATURES BY DILUTING ^{3}He IN ^{4}He. Neganov, B. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from report JINR-P13-4014. 33p. Dep. CFSTI.

An abstract of the original article appeared previously in NSA 22: 50093. (M.O.W.)

3397 (BNL-12971) COUPLING LOSSES IN SUPERCONDUCTING CAVITIES. Hahn, H.; Miller, J. M. (Brookhaven National Lab., Upton, N. Y.). [1968]. 7p. Dep. CFSTI.

The losses of a piston-type coupling mechanism which consists of a coaxial cable with a coupling loop and a below-cutoff tube coupled to the TE_{011} cavity through an iris were studied. The coupling to the cavity by means of waveguides can be made practically lossless and are not considered here. It was possible to derive expressions for the maximum measurable quality factor which suggest ways of reducing the residual losses due to the coupling mechanisms. Previously published Q measurements are analyzed in regard to coupling losses and it is concluded that the residual losses must have a different origin. (auth)

3398 (COO-1569-32) EXPERIMENTAL AND THEORETICAL STUDIES IN SOLID STATE AND LOW-TEMPERATURE PHYSICS. Annual Progress Report, 1968. (Minnesota Univ., Minneapolis. School of Physics). Sept. 1968. Contract AT-(11-1)-1569. 35p. Dep. CFSTI.

SUPERCONDUCTORS—Josephson junctions, studies of mixed state and fluctuations in
CRYSTALS—theory of quantum, studies
HELIUM—theory of quantum crystals of, studies; superfluid flow in fine channels, gyroscopic studies
HELIUM ISOTOPES He-3—nuclear spin of crystalline, studies of exchange and relaxation effects in
MANGANESE ALLOYS AND SYSTEMS—Mn–Sb, nuclear resonance in Mn_2Sb, relaxation study of hyperfine interaction; Cr–Mn–Sb, thermal capacity measurements on $Mn_{1.97}Cr_{0.03}Sb$ in spin reorientation region
MAGNETIC MATERIALS—spin reorientation transition in, theory; nuclear orientation experiments
TERBIUM—nuclear magnetic resonance studies
FILTERS—flow of superfluid helium through Millipore
REFRIGERATION—testing of molar dilution refrigerator
CRYOSTATS—performance of adiabatic demagnetization
(D.L.C.)

3399 (COO-1569-33) TRAPPING LIFETIME OF NEGATIVE IONS IN ROTATING SUPERFLUID HELIUM. Pratt, W. P. Jr.; Zimmermann, W. Jr. (Minnesota Univ., Minneapolis. School of Physics). Aug. 1968. Contract AT(11-1)-1569. 4p. (CONF-680808-7). Dep. CFSTI.

Measurements were made of the lifetime for the escape of negative ions trapped in rotating helium II as a function of temperature and pressure. These measurements concern lifetimes in the range from 10 to 1000 sec and were made between the temperatures of 1.09 and 1.68°K from the vaporization pressure to the solidification pressure. The results were analyzed in terms of the theoretical treatment of trapping based on the bubble model of the negative ion and the vortex-line model of the rotating liquid. (M.H.R.)

3400 (LA-tr-68-56) DEVIATIONS OF SURFACE IMPEDANCE OF IDEAL SURFACES IN WEAK FIELDS. Halbritter, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Translated for Los Alamos Scientific Lab., N. Mex., from report KFK-3/68-1. 12p. Dep. CFSTI.

Surface impedance in superconducting state and for weak rf fields, i.e., $H \ll H_{CRIT}$, can be calculated and the results agree quite well with experiments. An equally successful theory for fields close to H_{CRIT} and nonideal surfaces is missing. A dis-

cussion is presented of models which can be used to understand qualitatively the measured results and to allow predictions for important applications (accelerator cavities). First, critical rf magnetic fields are discussed. It can be deduced from the results of J. P. Turneaure and from other experiments on phase transitions that for real surfaces and long-lasting rf excitation, the amplitude has to be smaller than the critical magnetic field. A realistic limit for the field level depends on the increase of the surface resistance with amplitude. This increase for amplitudes close to the critical field but for ideal surfaces has been estimated to be less than a factor of 5. The measurements, too, have not yet indicated larger factors. For nonideal surfaces, one has first of all to understand the measured ageing effect of lead surfaces and the high residual resistance. It is shown that microroughness may be an explanation. Even an ideal superconductor will show a nonzero surface resistance for T = 0°K and Hy < energy gap. These losses are due to the mobility of the ions, i.e., excitation of phonons. The resulting surface resistance, however, is only about 10^{-10} ohms. The same phenomenon yields a similar value for an approximately 400-Å oxide layer on a pure metal. The influence of transverse phonon excitation, therefore, is generally negligible at the temperatures in question. (auth)

3401 (N-68-25859) 14 TESLA 15-CM BORE SUPERCONDUCTIVE MAGNET. Coles, W. D.; Schrader, E. R.; Thompson, P. A. (Radio Corp. of America, Harrison, N. J.). 1967. 15p. (NASA-TM-X-60367). CFSTI.

Design and construction of a 14-Tesla 15-cm bore superconductive magnet presented problems which were intensified by the size and field strength requirements. The magnet is a solenoid of approximate dimensions of 15-cm ID, 50-cm OD, and a length of 35-cm. The weight is approximately 1000 pounds and the stored energy when powered to maximum field strength approaches 2 megajoules. Selection of the conductor to match the field, strength, and stability requirements resulted in a modular design concept. An iterative computer program was used to optimize the design characteristics. Due to the large mass of the magnet, cooling of the internal parts was essential. This was accomplished by means of grooves and holes in the support structure which provided for the in-flow of liquid helium and for the escape of helium gas. Tests indicate: (1) The design and protection objectives were met. (2) Advantages offered by the magnet are: ripple free operation with little electrical noise; no acoustic noise or vibration; and a large volume at room or liquid helium temperatures. (3) Long charging time affects the magnet's utility for some experiments. (4) The magnet is probably over-protected but the degree to which protection could be reduced has not been assessed. (STAR)

3402 SUPERCONDUCTING SURFACE CURRENT EQUILIBRIA IN APPLIED FIELDS. Schweitzer, D. G. (Brookhaven National Lab., Upton, N. Y.). Phys. Lett., 28A: 98-9(Nov. 4, 1968).

The inclusion of surface energy terms in the London thermodynamics accounts for the properties of isothermal reversible paths observed on field reversals in hysteretic superconductors. (auth)

3403 MODIFICATION OF THE DEBYE-WALLER FACTOR OF SOLID HELIUM DUE TO SHORT-RANGE CORRELATIONS. Gillessen, P. (Institut fuer Theoretische Physik, Aachen); Biem, W. Z. Phys., 216: 499-506(17, 1968).

The Debye-Waller factor of solid ^{3}He and ^{4}He for both the bcc and the hcp phase is calculated using uncorrelated Gaussians multiplied with Jastrow functions to take the hard core into consideration. A correction of the coefficient of the usual harmonic exponent of the Debye-Waller factor is obtained which is quadratic in the momentum of about 30%. The coefficient of the next term which is of the fourth power in the momentum is negligible. (auth)

3404 THICKNESS DEPENDENCE OF THE RESISTIVE TRANSITION OF SUPERCONDUCTING FILMS. Naugle, D. C. (Univ. of Maryland, College Park); Glover, R. E. Phys. Lett., 28A: 110-11(Nov. 4, 1968).

Superconducting transition curves were measured for a series of amorphous bismuth films having thicknesses ranging from 100 to 2240 Å. Above the transition temperature, the electrical conductivity varied as $(T - T_c)^{-1}$. The constant multiplying this factor was found to be proportional to the residual resistance of the film. Values are in quantitative agreement with an expression based on the microscopic theory of superconductivity. (auth)

3405 SCATTERING OF LIGHT FROM ENTROPY FLUCTUATIONS IN ^{3}He-^{4}He MIXTURES. Ganguly, B. N.; Griffin, A. (Univ. of Toronto). Can. J. Phys., 46: 1895-1903(Sept. 1, 1968).

In 1957, Gor'kov and Pitaevskii showed that second sound in ^{3}He-^{4}He mixtures is strongly coupled into the concentration fluctuations, which, in turn, scatter light quite strongly (especially near the critical point). A more complete analysis is given of the fluctuations in density, entropy, and concentration. The discussion is based on the hydrodynamic equations of Khalatnikov, which assume that the ^{3}He atoms move with the normal fluid, and for simplicity all dissipative coefficients are omitted. Limitations were made to scattering from density and concentration fluctuations. The results for the first and second sound intensities agree essentially with those of Gor'kov and Pitaevskii. Near the critical point, second sound scatters light about six times more strongly than first sound does. (auth)

3406 LIQUID HELIUM AND THE PROPERTIES OF A BOSE-EINSTEIN GAS. II. EFFECTS OF FINITE GEOMETRY. Goble, D. F.; Trainor, L. E. H. (Univ. of Toronto). Can. J. Phys., 46: 1867-82(Sept. 1, 1968).

The properties of liquid helium in thin film geometry are studied using both the ideal Bose-Einstein gas and the hard-sphere gas as models. Of particular interest is the occurrence of a statistical correlation length which has roughly the same value in both models and which may help explain some recent experimental results on the behavior of liquid helium in thin films and pores. The limitations of the methods used for the interacting gas are discussed in some detail. (auth)

3407 THERMAL QUASI-PARTICLE RADIATION IN HELIUM II. Guernsey, Robert William Jr. St. Louis, Washington Univ., 1968. 219p.

Thesis.

The signals generated by a pulsed, small (~1 mm square) carbon film heater in a large volume (~300 cm^3) of helium-II between 120 and 950 m°K were studied with particular emphasis at the lower temperatures. The walls of the sample container were sufficiently distant to avoid interference between the early parts of the signal and reflections. The signals from carbon film detectors (~1 mm square) located at 1, 2, 3, and 4 cm from the source were photographed as the input power flux and sample temperature were varied. These are the first observations of reflection-free, thermal quasi-particle radiation in bulk helium II. Also included is a computation of the quasi-particle radiation expected from a helium II black-body source such as a heated cavity having a small hole in one side and immersed in the liquid at 0°K. An important difference between this problem and electromagnetic black-body radiation is that the helium II quasi-particles have widely differing velocities. Both wave number and velocity distributions are presented for fourteen source temperatures between 200 and 1500 m°K. Above 800 m°K, the radiation has two principal components; low-wave-number phonons of velocity 238 m/sec and quasi-particles from the low wave number side of the roton region which have velocity 131 m/sec. The total power flux radiated is proportional to T^4 up to about 700 m°K where it begins to increase more rapidly. The signal shapes expected at a given distance from the source for a square pulse output are computed for comparison with the above data. The signals observed at sample temperatures below 200 m°K and for heater power fluxes below 500 mW/cm^2 appear to consist of a phonon flux having the $1/R^2$ amplitude dependence expected of the spherical wave front and propagating without dispersion at a velocity of 234 ± 4 m/sec. A black-body source with output below 500 mW/cm^2 would radiate principally low-wave-number phonons for which no dispersion is expected. As the sample temperature is raised to 300 m°K and above, the signals begin to fall off faster than $1/R^2$. An absorption coefficient of 1 cm^{-1} is found at 307 m°K. The interpretation of this as the inverse of an effective phonon mean free path is discussed. Although the carbon film heater would appear to be a poor approximation to a black-body source, it is interesting that its signal does deviate from the form expected for low-wave-number phonons at just the output level which should generate other quasi-particles. The new signal does not have the characteristics expected for free quasi-particle radiation, but perhaps interactions precipitate some sort of aggregate mode. The evolution of the low-temperature signals into second sound is also shown. It is seen that the second sound signal from a point source should be proportional to the first time derivative of its power output. A square pulse then generates a signal consisting of a positive temperature spike at turn-on and a negative one at turn-off. Such signals are observed at sufficiently low output levels. (Disser. Abstr.)

3408 TENSILE STRENGTH OF LIQUID HELIUM. McCloud, Kenneth Lee. Columbus, Ohio, Ohio State Univ., 1968. 122p.

Thesis.

The tensile strength of liquid helium has been measured below the helium λ temperature under static conditions. Use was made of the helium "fountain pressure" to create the stress in the liquid. The values obtained for the tensile strength are larger than those found by ultrasonic cavitation methods, but smaller

than those from the spinning capillary technique. (Disser. Abstr.) (TSS)

3409 SUPERCONDUCTIVITY IN β-TUNGSTEN FILMS. Basavaiah, S.; Pollack, S. R. (Univ. of Pennsylvania, Philadelphia). J. Appl. Phys., 39: 5548-56(Nov. 1968).

Evaporated tungsten films were found to have a superconducting transition temperature T_c of 3.2°K as compared to the bulk value of 0.01°K. Structural study of the electron-beam-evaporated W films was carried out by both x-ray and electron-diffraction techniques. It was found that films prepared at pressures $>10^{-7}$ torr and evaporation rates <30 Å/min are a mixture of both the α and β phases, the β phase being the A15 structure, and the α phase being the bcc structure. It was established that the enhancement in T_c of these films is due to the presence of the β phase. Films prepared at 3×10^{-9} torr are pure α-W and they did not superconduct down to 1°K. The superconducting energy gap Δ(T) of the β-W films prepared at 5×10^{-6} torr and 25 Å/min was determined by tunneling in W–B–M junctions, where B is the plasma-grown oxide barrier on W and M stands for Sn, Pb, and Au counter electrodes. The temperature dependence of the energy gap $\Delta(T)/\Delta(0)$ vs T/T_c followed the BCS curve remarkably well. The ratio $2\Delta(0)/KT_c$ varied between 2.32 to 3.64 as against the BCS value of 3.53, corresponding to the variation in T_c between 3.1° to 3.3°K, respectively. The relative amounts of the α and β phases present were estimated from the tunneling experiments. The variations in T_c, $2\Delta(0)$, and $2\Delta(0)/KT_c$ are related to the relative amounts of α and β phases present in the composite film and their connectivity. (auth)

3410 MAGNETIC-FIELD DEPENDENCE OF JOSEPHSON CURRENT MODIFIED BY SELF-FIELD. Yamashita, Tsutomu; Kunita, Masanori; Onodera, Yutaka (Tohoku Univ., Sendai). J. Appl. Phys., 39: 5396-5400(Nov. 1968).

The magnetic-field dependences of the Josephson critical current were investigated in many high- and low-current Josephson junctions. The experimental results were different from the theoretically expected Fraunhofer diffraction pattern with respect to its period in magnetic field and the maximum critical current for high-current junctions. It was found that the first period of the magnetic-field dependence increased with the Josephson current and the maximum critical currents were reduced. The differences were interpreted as the influence of the self-field induced by the Josephson current. (auth)

3411 SPIN DIFFUSION COEFFICIENT OF WEAKLY INTERACTING SYSTEM OF ^{3}He ATOMS. Ueda, Seizo (Tokyo Univ.). J. Phys. Soc. Jap., 25: 986-8(Oct. 1968).

It is shown that the formulas for the spin diffusion coefficient D_s of the weakly interacting system of ^{3}He atoms in the regions of temperature much higher and much lower than the degenerate temperature of the system, which were given by Ebner and by Bardeen, Baym, and Pines in the respective regions of temperature by solving the kinetic equation, can be derived from the expression for D_s which has been obtained in the quantum statistical theory of spin echo. (auth)

3412 OBSERVATION OF HYPERFINE-ENHANCED NUCLEAR MAGNETIC COOLING. Andres, K.; Bucher, E. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett., 21: 1221-3(Oct. 21, 1968).

It is pointed out that the suitability of rare-earth ions in singlet ground states for the production of very low temperatures by means of nuclear adiabatic demagnetization. Nuclear cooling was observed in PrBi from an initial temperature of 0.026°K to a final temperature of 0.01°K. (auth)

3413 INFLUENCE OF HYDROGEN ON THE PROPERTIES OF Nb_3Sn. Ziegler, G. (Siemens AG, Erlangen, Ger.). Helv. Phys. Acta, 41: 1267-9(Oct. 20, 1968). (In German).

In Nb_3Sn samples prepared by precipitation from the gaseous phase by reduction of the chlorides with hydrogen, there were samples with a sharply decreased transition temperature and the lattice constants of these samples were higher than the stoichiometric intermetallic compound. Mass spectrometric analysis for hydrogen showed that the lattice constants increased with increasing hydrogen concentration. The decrease of the transition temperature with increase of the hydrogen concentration was shown. Annealing studies showed that the effects of Nb excess and hydrogen concentration are linearly superposed with respect to the lattice constant and transition temperature. (J.S.R.)

3414 INVESTIGATION OF THE THERMODYNAMIC PROPERTIES OF ^{3}He–^{4}He SOLUTIONS DURING THE HeI–HeII TRANSITION. Grigor'ev, V. N.; Esel'son, B. N.; Masimov, E. A.; Mikhailov, G. A.; Novikov, P. S. Zh. Eksp. Teor. Fiz., 55: 1160-7(1968). (In Russian).

The liquid–vapor phase diagram for ^{3}He–^{4}He solutions are investigated by the nuclear magnetic resonance method. The temperature dependence of the distribution coefficient is measured for six solutions with different amounts of ^{3}He. Singularities on the α(T) curves at T_λ predicted by the theory are found. Parts of the liquid–vapor phase diagram in the vicinity of the solution λ points are studied. The form of the diagram is studied in greater detail. Specific heat discontinuities at the λ points of the solutions are calculated on basis of the data obtained. With increase of concentration the specific heat jump for the He I–He II transition decreases. The heat of fusion and vaporization discontinuities are calculated. (auth)

3415 AGING IN Nb(Cb)–Ti–O SUPERCONDUCTORS, WITH APPENDIX. Rauch, G. C.; Courtney, T. H.; Wulff, J. (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME, 242: 2263-70(Nov. 1968).

The superconducting behavior of Nb–Ti alloys containing 40 and higher wt % of Nb and variable oxygen content was studied as a function of thermomechanical processing. Critical current density (J_c) vs applied transverse magnetic field (H) data were obtained for 0.010-in.-diam wires at 4.2°K in steady fields up to 120 kOe. The precipitate responsible for increase in J_c in each of the alloys studied was related to niobium and oxygen content. In alloys containing 40 to 60 wt % Nb with less than about 1600 ppm of oxygen, ω precipitation in the range 350 to 450°C appears to be responsible for the maximum value of J_c observed. In alloys of higher oxygen content (~2500 ppm), the oxygen-enriched α phase that precipitates in the temperature range 450° to 550°C is a more-effective fluxoid pinner. Maximum J_c in low-oxygen (350 ppm) 80 wt % Nb alloys was achieved by 600°C aging heat treatments. Measurements of resistive critical field also reflect the changes in composition accompanying precipitation in these alloys. (auth)

3416 MAGNETIC BREAKDOWN IN BERYLLIUM. Alekseevskii, N. E.; Egorov, V. S. (Inst. of Problems in Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 1153-9(1968). (In Russian).

Investigations of the resistance of single-crystal Be in a superconducting magnet are described. Oscillations of the resistance depending on the direction and strength of the magnetic field are observed. The oscillation amplitude sharply increases at field strengths of the order of 50 kOe. The largest amplitudes are observed for oscillations due to the appearance at H || [0001] of open trajectories in the hexagonal plane induced by magnetic breakdown. The existence of oscillations in a broad range of magnetic field directions is discussed. For all magnetic field directions the oscillation period corresponds to the central cross section of the Fermi-surface electron ellipsoids (the so-called cigars). The magnitude of the energy gap between the second and third bands in the $[11\bar{2}0]$ direction is about 6×10^{-3} Ry. (auth)

3417 EFFECT OF IMPURITIES ON THE EXISTENCE OF AN INHOMOGENEOUS STATE IN A FERROMAGNETIC SUPERCONDUCTOR. Aslamazov, L. G. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 1477-82(1968). (In Russian).

On decrease of impurity concentration, ferromagnetic alloys become unstable with respect to electron pairing with a nonzero total momentum, even when electron scattering on impurities is large. (auth)

3418 DEPENDENCE OF THE PINNING FORCE ON MAGNETIC FIELDS IN TYPE-II SUPERCONDUCTORS. LeBlanc, M. A. R.; Chang, C. T. M. (Univ. of Southern California, Los Angeles). Solid State Commun., 6: 679-83(Oct. 1968).

It was found that the surface "barrier," the diamagnetic magnetization, the residual flux and the critical current of Nb_3Zr and NbTi wires in transverse fields can all be enhanced by a factor of ≈3 by superimposing an axial magnetic field. This enhancement arises mainly because the pinning force density at the surface and in the bulk increases as B^n when $B \ll H_{c2}$ with $n \approx 0.7$ in Nb_3Zr. (auth) (UK)

3419 MAGNET COIL. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,134,515. Nov. 27, 1968. Priority date Apr. 17, 1965, Germany.

A magnet coil is designed for producing elongated transverse fields. The coil incorporates at least one elongate winding whose longitudinal sides extend parallel to one another and whose ends are bent up to form a saddle. The winding is constructed of individual layers, each consisting of individual wire turns lying along the longitudinal sides of the winding. A saddle-shaped winding support is formed with a slot for receiving the winding. The coil is advantageous where superconducting wires are used, as a compact packing of the winding is obtained and the winding support takes

up the forces exerted on the winding during operation. Various modifications of the coil design are described. (D.L.C.)

3420 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTING COILS. Cornish, Donald Nelson; Williams, John Eric Charles Watts (to United Kingdom Atomic Energy Authority). British Patent 1,131,491. Oct. 23, 1968. Filed Dec. 9, 1964.

Three ways are described for reducing the degradation due to flux jumping in a superconducting coil, for example of a hard Nb–Zr alloy. The flux jumping (magnetic field disturbances) occurs initially in only a restricted region of the coil, called the initiating region. The ways comprise surrounding only the initiating region with a good conductor (Cu or In), winding the initiating region with a different material such as Nb, and providing the initiating region with an auxiliary current source to reduce the magnetization therein. (D.L.C.)

3421 MAGNETIC IMPURITIES AND SUPERCONDUCTIVITY BELOW THE KONDO TEMPERATURE IN THE MODEL OF TAKANO AND OGAWA. Celli, V. (Univ. of Virginia, Charlottesville); Zuckermann, M. J. Nuovo Cim., 58B: 154-66(Nov. 11, 1968).

The behavior of dilute metallic alloys containing magnetic impurities is examined for temperatures below the Kondo temperature T_K. A Green's function treatment, similar to that of Takano and Ogawa, is used for the normal state, and is extended to evaluate the superconducting critical temperature T_c and the superconducting energy gap of such alloys in the limit $T_c \ll T_K$. (auth)

3422 A MODEL FOR MAGNETIC INSTABILITIES IN HARD SUPERCONDUCTORS: THE ADIABATIC CRITICAL STATE. Swartz, P. S.; Bean, C. P. (General Electric Research and Development Center, Schenectady, N. Y.). J. Appl. Phys., 39: 4991-8(Oct. 1968).

The isothermal critical-state model of hard superconductors is extended to include the effects of heating when the applied field is changed suddenly and magnetic flux enters adiabatically into the bulk. The following specific situation is considered: a semi-infinite slab of superconductor is cooled in a magnetic field lying in its surface plane; next, the external field is raised isothermally by an amount H_a, and this excess field decreases linearly to a depth $\delta = 10H_a/4\pi J_c$ from the surface; finally, the field is raised by an infinitesimal amount ΔH in a time short compared to the thermal diffusion time and long compared to the electromagnetic diffusion time. Each element of volume exposed to the changing field receives a thermal impulse proportional to the local-flux-change times J_c. This thermal impulse, in turn, lowers the critical current and allows more flux to penetrate. It is found that if H_a exceeds some critical value H_{fj}, then the isothermal critical state is not the only allowed state of the superconductor. This instability field is given in terms of the critical current density J_c, derivative of the critical current density with temperature, $\partial J_c/\partial T$, and the volume specific heat C by the formula $H_{fj} = [-\pi^2 C J_c/(\partial J_c/\partial T)]^{\frac{1}{2}}$. The application of the incremental field ΔH can initiate an avalanching process, or a flux jump, that terminates in an adiabatic critical state. Immediately following the flux jump the internal field, the induced supercurrent, and the temperature rise at each position are associated in a self-consistent way with the avalanche of flux that has entered the superconductor. In this framework a flux jump is viewed as a switching from the isothermal critical state to an adiabatic critical state. The magnitude of the jump is related to J_c and is calculated. (auth)

3423 GENERALIZED CRITICAL-STATE MODEL OF TYPE-II SUPERCONDUCTORS. Dunn, W. I.; Hlawiczka, P. (Glasgow Univ.). J. Phys., D (London), 1: 1469-76(Nov. 1968).

A modified form of the critical-state model of type-II superconductors is described which takes account of H_{c1} and surface sheath currents. The penetrating flux, hysteresis loop characteristics, ac losses and rate of penetration of flux into the superconductor when exposed to a sinusoidal magnetic field are evaluated. The model implies zero power dissipation for peak applied fields less than $H_{c1} + \Delta H$ and rapidly increasing dissipation just above this region, asymptotically approaching that derived from the Bean–London model. (auth) (UK)

3424 SURFACE STRUCTURE AND ac LOSSES IN SUPERCONDUCTIVE NIOBIUM. Easson, R. M.; Hlawiczka, P. (Glasgow Univ.). J. Phys., D (London), 1: 1477-85(Nov. 1968).

The effect of different surface treatments on flux penetration and dissipation at 50 Hz in bulk niobium samples was quantitatively investigated. It was shown that for a sufficiently smooth sample surface the onset of ac dissipation occurs when the peak applied magnetic field exceeds $H_{c1} + \Delta H$, in striking contrast to earlier results. A comparison of experimental results with a generalized critical-state model yielded good agreement. (auth) (UK)

3425 STABILISING THE SUPERCONDUCTOR. Barber, A. C. (Imperial Metal Industries, Ltd., Eng.). Copper (London), 2: 2-4(Nov. 1968).

The use of copper in stabilizing superconducting alloys against degradation by changes in magnetic flux distribution is discussed, with particular regard to the development of large electromagnets. (UK)

3426 SUPERCONDUCTIVITY IN SMALL CRYSTALLITES. Hurault, J. P. (Faculte des Sciences, Orsay, France). J. Phys. Chem. Solids, 29: 1765-72(Oct. 1968).

The superconducting properties of small metallic crystallites coated with a polarizable material were studied. At the vicinity of the interface there are two mechanisms which could favor superconductivity: (1) the phonon spectrum is modified; and (2) the electrons can be attracted through the exchange of a polarization wave of the dielectric. An experimental procedure is proposed to determine which mechanism is effective. (auth) (UK)

3427 DEPENDENCE OF THE LOWER CRITICAL FIELD ON NORMAL-STATE RESISTIVITY IN SUPERCONDUCTING ALLOYS. Echarri, A.; Witcomb, M. J.; Dew-Hughes, D.; Narlikar, A. V. (Univ. of Lancaster, Eng.). Phil. Mag., 18: 1089-92(Nov. 1968).

A simple relationship between the lower critical field and the normal state resistivity for type-II superconducting alloys, based on the Maki (1964) theory, was obtained. The theoretical predictions are compared with experimental results obtained on a Mo–34% Re alloy cold worked by varying amounts. (auth) (UK)

3428 SUPERCONDUCTING SADDLE-SHAPED MAGNETS. Doi, T.; Kimura, H.; Sato, S.; Kuroda, K.; Ogata, H.; Kudo, M.; Kawabe, U. (Hitachi, Ltd., Tokyo). Cryogenics, 8: 290-4(Oct. 1968).

With a view to settling the optimum design data on the magnet for an MHD generator three assemblies of Hisuper strip-wound superconducting saddle-shaped magnets were constructed and tested. The results are reported. (auth) (UK)

3429 SUPERCONDUCTING RESONATOR–SOLENOID. Blagosklonskaya, L. E.; Gershenzon, E. M.; Serebyrakova, N. A.; Shebalin, I. Yu. (Moscow State Pedagogical Inst.). Cryogenics, 8: 323-4(Oct. 1968).

The design of a resonator–solenoid, which combines a superconducting solenoid and a spiral resonator, the cylindrical surface of which forms the inner part of the solenoid winding, is described. With this design the dimensions of the system may be optimized, and it is possible to realize the satisfactory Q value of a wire resonator of superconducting material, and simplify considerably the whole construction, since the resonator–solenoid can be placed in a normal helium dewar. (UK)

3430 INTRINSIC TYPE-2 SUPERCONDUCTIVITY IN PURE NIOBIUM. French, R. A. (Geophysical Service International Inc., Dhahran, Saudi Arabia). Cryogenics, 8: 301-8(Oct. 1968).

Accurate magnetization experiments on niobium ($\Gamma > 2{,}000$) from the superconducting transition temperature of 9.20 ± 0.03°K to 1.5°K produced highly reversible curves. Dc resistance measurements, yielding H_{c3}/H_{c2} ratios of 3.4 to 3.65, suggest this to be partly due to poor surface finish. Temperature change altered the shape of the magnetization curves, which displayed a discontinuity in dM/dH at 1.005 H_{c1} and continuous nonlinear approach to $M = 0$ at H_{c2}. Data were consistent with a λ transition at H_{c1}. Thermodynamic critical fields $H_c(t)$ obeyed the parabolic law, indicating strong coupling: $2\epsilon(0)$ was 3.67(±0.05) kT_c. Nearer T_c, the energy gap followed the BCS expression $\epsilon(t)/\epsilon(0) = B^{\frac{1}{2}}(1-t)$ for B = 3.9(±0.2). Other parameters were $\xi_0 = 390(\pm 15)$ Å, $\lambda_L(0) = 333(\pm 15)$ Å, $S/S_f = 0.79$, and $\kappa_0 = 0.815(\pm 0.015)$. The Maki functions $\kappa_1(t)$, $\kappa_2(t)$ were in fair accord with theory, but changed rapidly with temperature, $\kappa_1(0)/\kappa(1)$ being 1.68, (30% too high). This discrepancy is not explained in nonlocal corrections to GLAG theory. Temperature variation of H_{c1}/H_c differed from theoretical prediction. (auth) (UK)

3431 STRENGTHENING SUPERCONDUCTING COMPOSITE CONDUCTORS FOR LARGE MAGNET CONSTRUCTION. Taylor, M. T. (Central Electricity Research Labs., Leatherhead, Eng.); Woolcock, A.; Barber, A. C. Cryogenics, 8: 317-19(Oct. 1968).

The simplest solution to the high mechanical forces exerted in large superconducting electromagnets is to strengthen the conductor. Three methods of strengthening a superconducting alloy/copper composite conductor are examined. The results indicate the best method of strengthening is to work harden the copper. (auth) (UK)

3432 NONEQUILIBRIUM THERMODYNAMICS OF SUPERCONDUCTING ALLOYS IN HIGH MAGNETIC FIELDS. Weller,

W. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Status Solidi, 30: 373-8(Nov. 1, 1968).

A superconductor with nonmagnetic impurities is considered in the limiting case of small mean free path ($l \ll \xi_0$) and high magnetic field ($H \approx H_{c2}$). The principles of the phenomenological nonequilibrium thermodynamics are applied to the superconductor and the dissipation function is calculated. For the free energy of the superconductor, a functional is used which leads in the equilibrium case to Maki's generalized Ginzburg–Landau equation. However, the current density resulting from this functional differs in the order of the operators from Maki's expression. The results of the phenomenological considerations are in agreement with the time-dependent Ginzburg–Landau equation recently obtained by Caroli and Maki from the microscopic theory. (auth)

Plasma and Thermonuclear Physics

Refer also to abstract 3169.

3433 (NP-tr-1699) PLASMA PHYSICS. Fucks, Wilhelm; Waelbroeck, Francois (Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronenphysik). Translated for Culham Lab., Abingdon, Eng., from pp 1-6 of 1966 Annual Report. 15p. (CTO-512). Dep. CFSTI. UK.

The main subjects of investigation at the Institute are the following: (1) The generation, heating, and containment of plasma at very high temperatures and densities. Extensive measurements were carried out (θ-tron) on plasmas trapped in magnetic fields on the 600-kJ experiment to obtain information about the stability of this configuration. The 40-kV experiment was used for the study of heating parameters. The Cusp experiment was fitted with a crowbar, and first results about containment times were obtained. (2) Shock-wave investigations. In a range of parameters specially accessible to experimental measurement and theoretical treatment, satisfactory qualitative agreement was obtained between theoretically expected and actually observed results, both for perpendicular and oblique incidence of the wave. (3) Plasma Acceleration. New developments are reported on a 100-kV filter to reach a higher plasma velocity. Measurements on fundamentally different model experiments were made on the continuous acceleration of plasmas with recovery of the energy input. These experiments have provided the optimum design data for a larger project. (auth)

3434 (UCRL-50002-68) CONTROLLED THERMONUCLEAR RESEARCH. Annual Report, July 1967–June 1968. (California Univ., Berkeley. Lawrence Radiation Lab.). July 10, 1968. Contract W-7405-eng-48. 228p. Dep. CFSTI.

Separate abstracts were prepared for the 6 included sections. (M.O.W.)

For abstracts of individual sections see: 3444–3448, and 3469.

3435 FISICA DEL PLASMA. Convegno Indetto Dalla Societa Lombarda di Fisica, Milano, 6–7 Maggio 1963. (Plasma Physics. Meeting of the Lombarda Physics Society, Milan, Italy, May 6–7, 1963). Congressi, Convegni e Simposi Scientifici 8. Roma, Consiglio Nazionale delle Ricerche, 1965. 267p. $10.00; Lire 5000. (In Italian). (CONF-468).

Twenty-one papers are included. Both laboratory and astrophysical plasma studies are presented. (M.O.W.)

Confinement and Heating

3436 (CLM-R-82) PLASMASCOPE OBSERVATIONS OF PLASMA IN A MAGNETIC FIELD. Atkinson, D. W.; Phillips, J. A. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Mar. 1968. 19p. Dep. CFSTI. UK 6s.

A plasmascope was used to observe the behaviour of plasma particle density $\sim 10^{10}$ to 10^{11} cm^{-3}, and velocity $\sim 5 \times 10^7$ cm sec^{-1}, injected by a coaxial plasma gun into a longitudinal magnetic field of 780 gauss; also plasma of particle density $\sim 10^{14}$ cm^{-3}, and velocity $\sim 10^8$ cm sec^{-1}, injected and trapped in a magnetic mirror. Plasmascope observations on the plasma of the MTSE I experiment showed no evidence of instabilities at early times for the simple mirror of minimum-B configurations. (auth) (UK)

3437 (CLM-R-95) PROPERTIES OF LINEAR FILAMENTARY MULTIPOLE MAGNETIC FIELDS. Hobbs, G. D.; Taylor, J. B. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Apr. 1968. 18p. Dep. CFSTI. UK 3s. 0d.

A catalogue of the properties of the vacuum magnetic fields generated by a class of linear multipoles is presented. (auth) (UK)

3438 (IAE-1630) STUDIES OF ELECTRON HEATING MECHANISM DURING ELECTRON BEAM INTERACTIONS WITH PLASMA. Karkhov, A. N. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 20p. (In Russian). Dep.

Studies were made of conditions of electron heating and spectral oscillations excited in plasma by electron beams. Data obtained indicate that the circularly polarized electromagnetic waves propagating along the external magnetic field are responsible for electron heating. (tr-auth)

3439 (MATT-607) CALCULATION OF BOHM AND CLASSICAL DIFFUSION IN THE SPHERATOR SP-1. von Goeler, S.; Christensen, U.; Fishman, H. (Princeton Univ., N. J. Plasma Physics Lab.). Sept. 1968. Contract AT(30-1)-1238. 21p. Dep. CFSTI.

The particle flux through a magnetic surface has been computed for different configurations of the Princeton Spherator SP-1 for both classical and Bohm diffusion. The corresponding eigenvalue problem has been solved for Bohm diffusion. (auth)

3440 (NP-17655) STUDIES OF SUPERHIGH-FREQUENCY HEATING OF PLASMA IN MAGNETIC FIELD. Anisimov, A. I.; Budnikov, V. N.; Vinogradov, N. I.; Golant, V. E.; Nanobashvili, S. I.; Obukhov, A. A.; Lakhomov, L. P.; Piliya, A. D.; Fedorov, V. I. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1968. 23p. (In Russian). Dep.

The feasibility of expanding the range of conditions for effective introduction of superhigh-frequency energy into plasma is discussed. The results of theoretical studies of wave absorption by collisionless plasma are interpreted in detail. The experiments on formation and heating of plasma by superhigh-frequency waves are described and the effective wave absorption region was found. It is shown that effective wave absorption related to linear transformation can be realized in a wide range of conditions and effective introduction of superhigh-frequency energy into plasma in a wide range of parameters (with magnetic fields from small intensities up to magnitudes exceeding cyclotron fields and particle concentrations from less than critical up to the magnitudes exceeding the critical by order of two). (R.V.J.)

3441 (NP-17665) MASS-ENERGETIC MEASUREMENTS OF PLASMA ENTRAPPED INTO THE APERTURE OF THE DIVERTER DURING INJECTION THROUGH THE MAGNETIC GAP. Zalkind, V. M.; Zikov, V. G.; Karpukhin, V. I.; Pudnev, N. I.; Tolok, V. T. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1968. 12p. (In Russian). Dep.

With the help of a Thomson mass spectrograph and a flight mass spectrometer, the energy spectra, mass structure, and other parameters of a plasma, entrapped in the aperture of the diverter during an external injection through its magnetic gap from a coaxial plasma gun, were studied. It was shown that there is an optimal intensity of magnetic field during which there occurs the greatest percentage of absorption of hydrogen ions along the axial force lines of the magnetic field. The best absorption of the high-energy ions occurs approximately in this range of the magnetic fields. (tr-auth)

3442 (NP-17666) INVESTIGATION OF THE POSSIBILITY OF THE INJECTION OF A PLASMA INTO THE STELLARATOR "SIRIUS" THROUGH THE DIVERTER. Zykov, V. G.; Rudnev, N. I. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1968. 12p. (In Russian). Dep.

Experiments in the study of the movement of a plasma, injected through the gap of the diverter, prepared for the stellarator "Sirius," are described. The injection was made from a coaxial source. With the help of a plasmascope, the distribution of the plasma within the chamber of the diverter, during various intensities of the magnetic field (up to 20 ke(kiloelectrons)), was observed. The experiments showed that a significant part of the plasma is trapped by the magnetic flux, extracted through the gap of the diverter, and moves along the lines of force of the magnetic field. A part of the plasma, which enters the ring region, where the magnetic field is zero, is distributed in the form of a complete tube in opposing directions along the longitudinal axis of the diverter near the diverter surface. Another part of the plasma intersects the chamber of the diverter across the magnetic field. With the help of the 8-mm interferometer, the density of the trapped plasma, depending upon the intensity of the magnetic field, was determined. The distribution of the density of the plasma, in accordance with the cross section of the chamber and the total of the trapped particles, was measured by a screened electric sonde. (tr-auth)

3443 (NP-tr-1701) TRANSFER PROCESSES IN TOROIDAL SYSTEMS. Kovrizhnykh, L. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Culham Lab., Abingdon, Eng., from Preprint No. 98. 17p. (CTO-542). Dep. CFSTI. UK.

Expressions are derived for the particle and energy fluxes across the magnetic field in toroidal magnetic systems of various types such as the Tokamak, Levitron, Stellarator, "corrugated" Torus, for fully and weakly ionized plasmas. It follows that, given a sufficiently small collision frequency, consideration of the toroidicity leads to a significant increase of the coefficients of diffusion and thermal conductivity compared to straight systems (i.e., $\delta = r/R = 0$). A region of parameters (low collision frequencies or sufficiently high electric fields) appears to exist where the transfer coefficients are independent of the magnetic field strength. (auth)

3444 (UCRL-50002-68, pp 1-22) THEORETICAL STUDIES. (California Univ., Berkeley. Lawrence Radiation Lab.).

Summaries of theoretical research during July 1967–June 1968 are given for the following: (1) mirror research, (2) Astron research, (3) toroidal design, and (4) nonlinear dynamics. (M.O.W.)

3445 (UCRL-50002-68, pp 23-64) MAGNETIC MIRROR PROGRAM. (California Univ., Berkeley. Lawrence Radiation Lab.).

Summaries of research work on the Multistage High-Compression Experiments are given for the following: (1) nature of the high-density plasma, and (2) plasma losses and mode identification. Research progress on the Table Top IV experiments is described in terms of (1) polarization measurements, (2) instability growth rate, and (3) beam injected and Lorentz trapped hot electron plasma. Work on the Alice experiments include: (1) beam development, (2) vacuum and surface physics, (3) deflection of streaming atoms by absorption of resonance radiation, (4) data acquisition system for Alice facility, and (5) computed particle distributions for multiple beams in the Alice quadrupole magnetic field. (M.O.W.)

3446 (UCRL-50002-68, pp 65-163) ASTRON PROGRAM. (California Univ., Berkeley. Lawrence Radiation Lab.).

Theoretical research progress is reported for the following: (1) magnetic field distribution for a thick E layer, (2) energy and scattering loss of the E-layer electrons, (3) upper limit of electron losses during E-layer buildup, (4) precessional oscillations, (5) preliminary investigation of the properties of a scaled-up Astron, (6) ignition of a plasma undergoing Bohm diffusion, and (7) an inexpensive experiment to demonstrate a proton E layer. Experimental research is reported for the following: (1) precessional oscillations, (2) precessional motion in the new Astron tank in the high-vacuum regime, (3) high-vacuum trapping in the new Astron with and without resistors, (4) multiple pulse injection in Astron, (5) rf measurements in the new Astron tanks, (6) beam quality measurement on the Astron accelerator, (7) Astron model code RESIST, and (8) improvements of the Astron facility now under construction. (M.O.W.)

3447 (UCRL-50002-68, pp 164-73) TOROIDAL CONFINEMENT PROGRAM. Anderson, O. A. Jr.; Birdsall, C. K.; Birdsall, D. H.; Hartman, C. W.; Lauer, E. J.; Munger, R. H.; Taylor, C. E. (California Univ., Berkeley. Lawrence Radiation Lab.).

Summaries of research work are presented for the following: (1) Levitron experimental results, (2) superconducting Levitron studies, (3) neutral injection in a torus, (4) gun-plasma guide-field experiment, (5) hybrid multipole-stellarator (Hybritron), and (6) alkali-metal plasma facility. (M.O.W.)

3448 (UCRL-50002-68, pp 190-210) ENGINEERING DEVELOPMENT. (California Univ., Berkeley. Lawrence Radiation Lab.).

Summaries of research on the mechanical engineering development of the following are given: (1) magnetic mirror program, (2) Astron, (3) Levitron-S, (4) NASA–HAPPE superconducting coil project, and (5) component development. Electronics development is discussed for the following: (1) magnetic mirror program, (2) Astron program, (3) toroidal-confinement program, (4) basic experimental plasma physics program, (5) cryogenic project, and (6) advanced technology and systems analysis. (M.O.W.)

3449 UDERZHANIE PLAZMY V STELLARATORAKH. (Plasma Confinement in Stellarators). Shpigel, I. S. (ed.). Preprint No. 94. Moscow, Lebedev Institute of Physics, 1968. 80p.

Ten articles are included on plasma confinement in stellarators Liven'-1, Tor-1, and Tor-2. The first two articles include data on quasi-static electric fields of plasma and the relation between the magnitude of floating potential and the magnitude of intensity and magnetic field configuration in the Liven'-1 stellarator. The amplitudes and spectra of plasma density noises as functions of conversion angle and observation point coordinate are covered in the third article. Data on electron cyclotron resonance applications for heating electrons and resulting plasma diffusion rate increase are analyzed in the fourth article. Pulsed vacuum measurements in stellarator Liven'-1 during injected plasma decay in the chamber are discussed in the following chapter. The two new Stellarator installations, Tor-1 and Tor-2, constructed with high precision and operating with up to 20- to 30-kG fields, are described in the sixth, seventh, and eighth articles. The last two articles include the theory of charge localization in a conical induction source with reduced content of admixtures and the development of a photoelectric spectrum analyzer for density and noise studies. (R.V.J.)

Diagnostics

Refer also to abstracts 2255 and 3469.

3450 (IPPJ-DT-9) PROBE METHOD FOR MEASURING PLASMA PARAMETERS IN GAS DISCHARGES. Dote, Yoshikiko (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct. 1966. 105p. (In Japanese).

The use of Langmuir and other-type probes for measurements in gaseous-discharge plasma is reviewed. (49 references). (M.O.W.)

3451 (N-68-27559) THEORY OF STARK BROADENING OF SPECTRAL LINES IN A PLASMA. Oertel, G. K. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Nov. 5, 1966. 14p. (NASA-TM-X-59416). CFSTI.

The theory of Stark broadening of isolated spectral lines by electrons in a plasma was developed by Griem, and numerical results were obtained for a large number of neutral and singly ionized spectral lines. Large discrepancies between measured and predicted widths of ion lines have led to a reinvestigation of the underlying assumptions. It is shown that the calculated widths do not change by more than a few percent as a result of certain corrections. The effect of different strong collision cutoff procedures is as important but still far too small to explain the experimental result for ions. Debye shielding must often be taken into account in the electron density determinations from broadening of neutral lines in typical experiments and was therefore built into a computer program for electron impact widths. The results are compared with estimates on the basis of the usual procedure for estimating Debye shielding effects. (auth) (STAR)

3452 (NP-tr-1670) HIGH RESOLUTION OF PIEZOELECTRIC PRESSURE PROBE. Katsaros, W. Translated from Z. Angew. Phys., 22: 537-44(1967). 18p. (CTO-487). CFSTI.

An abstract of the original article appeared previously in NSA 21: 24253. (M.O.W.)

3453 (NP-tr-1671) REACTION NEUTRONS AS A TOOL IN PLASMA DIAGNOSTICS. Lehner, G.; Pohl, F. Translated from Z. Phys., 207: 83-104(1967). 28p. (CTO-485). Dep. CFSTI. UK.

An abstract of the original article appeared previously in NSA 21: 35145. (M.O.W.)

3454 EXPERIMENTAL INVESTIGATION OF FLUCTUATIONS IN A NONEQUILIBRIUM MHD PLASMA. Kerrebrock, Jack L.; Dethlefsen, Rolf (Massachusetts Inst. of Tech., Cambridge). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2115-21(Nov. 1968).

The electrical fluctuations in an argon–potassium nonequilibrium plasma have been studied over a wide range of Hall parameter and electron-to-gas temperature ratios. For electron densities above 2×10^{13} cm^{-3}, the fluctuations increase greatly in intensity as the Hall parameter exceeds a critical value. The variation of the critical value with electron temperature is in accord with the electrothermal wave stability theory. For electron densities below 2×10^{13}, the behavior of the fluctuations seems in accord with the theory of magnetoacoustic waves except that the theoretically predicted growth rates seem too small to explain the measured amplitudes. The transition at an electron density of 2×10^{13} is probably due to the reduced ionization rate, which limits the growth rate of electrothermal waves. Substantial reductions of effective conductivity and Hall parameter are associated with the fluctuations for both high and low electron densities, at large Hall parameter, although the reduction is greatest at large electron densities. (auth)

3455 SPECTRAL LINE INTENSITIES IN A NONEQUILIBRIUM NITROGEN PLASMA. Park, C. (Ames Research Center, Moffet Field, Calif.). J. Quant. Spectrosc. Radiative Transfer, 8: 1633-53(Oct. 1968).

For given ratios of nonequilibrium to equilibrium ground-state

number density, and given electron temperatures, the relative populations of excited states of atomic nitrogen in a collision-dominated nonequilibrium plasma, consisting of atoms, singly charged ions, and electrons are calculated by the method of Bates, Kingston, and McWhirter (Proc. Roy. Soc. (London), Ser. A, 267: 279(1962) and 270: 155(1962)). This method uses Gryzinski's semiclassical cross sections for the collisional excitation of electronic states of an atom. From the resulting populations the spectral intensities of two prominent visible lines are calculated, assuming the plasma to be optically thin for these lines. It is shown that, with the exception of a decaying plasma at temperatures greater than 8000°K, the calculated nonequilibrium intensities disagree with the equilibrium spectral line intensities that would be conventionally employed to determine the temperature of a plasma in equilibrium. (auth) (UK)

3456 A NEW TECHNIQUE FOR MEASUREMENTS OF RADIAL DISTRIBUTIONS OF EXCITED SPECIES IN PLASMAS AND ITS APPLICATION TO CAPILLARY DISCHARGES IN ARGON. Webb, C. E. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 39: 5441-70(Nov. 1968).

A novel technique is described for obtaining the radial profiles of individual emission lines from a plasma directly in the form of a recorded trace of intensity vs radial position. The method employs an "end-on" collimation technique which eliminates the complicated data reduction treatment required by conventional "side-light" methods. Spatial resolution and instrumental distortion effects are discussed. The method is applied in an experimental study of the capillary discharge in argon, and the relevance of the results to the excitation mechanisms of the c–w Ar II laser is indicated. In particular, it is found that populations of excited Ar I states are substantially independent of the local electron density over wide ranges of plasma parameters, an effect which is attributed to the predominance of electron-impact-induced transfers over radiative transfers for the Ar I states. The populations of excited states of Ar II are found to have profiles which are in agreement with those predicted by a plasma model in which (a) the ion loss is controlled by ambipolar diffusion at higher pressures with a steady approach towards an essentially collisionless "free-fall" motion occurring as the pressure is decreased, and (b) excitation to the Ar II excited levels proceeds stepwise via the Ar II ground state. The method is of general applicability to problems involving spatial variations in plasmas, and has been coupled with high-resolution interferometric techniques to provide direct measurements of spatial dependence of spectral line-broadening parameters. (auth)

3457 ULTRAHIGH-FREQUENCY DISCHARGE IN ATMOSPHERIC-PRESSURE GAS. Murayama, Seiichi (Hitachi, Ltd., Tokyo). J. Appl. Phys., 39: 5478-84(Nov. 1968).

A 2469-MHz discharge was generated at an open end of a coaxial waveguide, through which atmospheric-pressure gas flowed. Argon served as a plasma-forming gas, hydrogen and calcium as probe elements for the measurement of electron density and gas temperature, respectively, and sodium as a seed for increasing electron density. The density of excited hydrogen atoms, the excitation temperature, the electron density, the ionization temperature, and the gas temperature were measured at operating powers of 50, 200, and 400 W. The plasma in the close vicinity of the electrode (0 to 0.5 mm from the terminus of the inner conductor) was not in the local thermal equilibrium at any power level investigated, independently of the sodium seeding. At a distance between 1 and 3 mm from the electrode, on the contrary, the nonseeded plasma approached the local thermal equilibrium when the power was increased, while the seeded plasma exhibited a deviation from the local thermal equilibrium. The deviation from the local thermal equilibrium in the nonseeded plasma can be interpreted to be due to inhomogeneity of the plasma. In the outer zone of the seeded plasma, the excitation temperature was equal to the gas temperature but not to the ionization temperature. A separation of plasma components occurred which was depressed by the sodium seeding. (auth)

3458 FAR-INFRARED LASER INTERFEROMETRY FOR ELECTRON DENSITY MEASUREMENTS. Turner, R.; Poehler, T. O. (Johns Hopkins Univ., Silver Spring, Md.). J. Appl. Phys., 39: 5726-31(Nov. 1968).

A far-infrared laser interferometer suitable for use with thin, transient plasmas of densities from 10^{14} to greater than 10^{17} cm^{-3} has been developed. A HCN gas laser operating at 337 and 128 μm and a H_2O gas laser operating at 119, 79, and 48 μm are used as sources for a Mach-Zehnder interferometer, fast InSb and Ge:Ga detectors are used to measure the phase shift produced by the plasma. The interferometer has been used to study the output of a plasma gun which produces a plasma 4 cm in diameter and average density greater than 10^{15} cm^{-3}, a plasma not suitable for microwave or optical interferometry. (auth)

3459 TIME-RESOLVED SPECTROSCOPIC DIAGNOSIS OF A PLASMA CREATED BY FOCUSING OF A LASER BEAM ON A GAS. Cesari, Claude; Consoli, Terenzio; Jacquot, Claude; Stevenin, Pierre; Slama, Lucien; Yokoyama, Masahiro (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 267: [illegible](Aug. 26, 1968). (In French).

An experiment is described for ultra-fast spectroscopic diagnostics of a plasma created by means of a triggered laser. All of the spectral data are obtained during a single firing. (tr-auth)

3460 NEW DATA CONCERNING THE BROADENING AND SHIFT OF Ar I AND Ar II SPECTRAL LINES IN A SPARK PLASMA. Iova, Iancu (Univ., Bucharest). Rev. Roum. Phys., 13: 267-73(1968).

The broadening and shift of atomic and ionic lines in a spark plasma at 4 atm, under the action of electron and ion local fields, were investigated. For an electron concentration of $N_e = 1.6 \times 10^{16}$ cm^{-3} and an electron temperature of $T_e = 21{,}300$°K the agreement between theory and experiment falls within 10% for line broadening; at the same time the measured values of the line shift are generally larger than those predicted theoretically by about 20%. Various parameters and atomic and ionic constants, which characterize plasma radiations, are also given. (auth)

3461 TECHNIQUE FOR MEASURING THE ELECTRON DENSITY OF DENSE, THICK, STEADY-STATE PLASMAS. Caron, Paul R.; Russo, Frank (Electronics Research Center, Cambridge. Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-16: 611-12(Sept. 1968).

A technique for measuring the electron density of dense, thick, steady-state plasmas using a swept microwave interferometer is described. An expression is developed relating the average electron density to a phase shift less than 180° when the phase change introduced by the plasma is large. (auth)

3462 THEORETICAL CONSIDERATIONS ON THE FORWARD POSITIVE MOVING STRIATIONS. Yamashita, Yoshihiko; Yoshimoto, Hiroshi (Okayama Univ., Japan). J. Phys. Soc. Jap., 25: 1203(Oct. 1968).

It is shown here that forward positive moving striations are also described semi-quantitatively by the same approximate dispersions used previously for forward negative moving striations. (M.H.R.)

3463 THE DETERMINATION OF ELECTRON DENSITY BY MEANS OF A CYLINDRICAL TM_{010} MICROWAVE CAVITY. Lukac, P. (Komensky Univ., Bratislava). J. Phys., D (London), 1: 1495-9(Nov. 1968).

The calibration of a cylindrical TM_{010} microwave cavity for measuring the electron density in a long cylindrical plasma column is described for the case where the radius of the plasma column, the thickness of the glass discharge tube and the radius of the cavity are comparable. A comparison of the experimental value with that calculated by solution of Maxwell's equations is also made. Good agreement between these values is obtained, the error being less than 5%. It is also shown that there is a large difference between these values and those calculated according to perturbation theory. (auth) (UK)

3464 LINE EMISSION FROM ALUMINUM AND LITHIUM PLASMA AT 5000 TO 100,000°K TEMPERATURES. Derevshchikov, V. A.; Deryabina, M. A. (All Union Research Inst. of Electromechanics, Moscow). Teplofiz. Vys. Temp., 6: 919-20(Sept.-Oct. 1968). (In Russian).

Upper limits of line emission from carbon and fluorine plasma of density 10^{16} to 10^{18}/cm^3 were studied previously at temperatures up to 100,000°K. A similar study is reported here with aluminum and lithium plasma at 5000 to 100,000°K. Comparison of data shows that the energy emitted by aluminum plasma at temperatures up to 30,000°K was considerably higher than the energy emitted by carbon and fluorine plasma. Decreasing energy related to the appearance of triply charged aluminum ions with a closed electron shell appeared at lower temperatures than in the case of carbon or fluorine plasma. However, reverse results appeared for the energy emitted by Al, C, and F plasma at temperatures exceeding ~40,000°K. As in the case of carbon plasma, a considerable increment of radiation energy was observed with the increased particle density. The main part of the line emission, as in the case of carbon and fluorine plasma, was found in the vacuum ultraviolet area. In the temperature range from 15,000 to 60,000°K, the radiation energy of lithium was lowest and could be neglected in comparison with the kinetic energy at particle velocities of 10^6 to 10^7 cm/sec. (R.V.J.)

3465 SATURATION ELECTRON CURRENT IN A MAGNETIC FIELD. Akazaki, Masonori; Watanabe, Yukio (Kyushu Univ., Fukuoka). Jap. J. Appl. Phys., 7: 1534-8(Dec. 1968).

In connection with the saturation electron current of a disk probe in a magnetic field, quantitative comparisons of experimental results with theoretical results are made for the large ratio of the electron mean free path λ_e to the Debye length λ_D, $10^2 \sim 10^3$. By taking account of the region of free motion of electrons between the probe and the diffusion region, the numerical conformity between these two results is reasonably improved. When $(\omega_e\tau_e)^2 \gg 1$ (ω_e: the electron frequency, τ_e: the electron mean collision time) and λ_e/r_p (r_p: the probe radius) is relatively large, the rate of the decrease in the saturation electron current caused by a magnetic field is approximately expressed as a function of the Larmor radius r_g and can be estimated by the measurable parameters of the electron temperature and the magnetic field instead of uncertain parameters λ_e and τ_e. (auth)

Kinetics

Refer also to abstract 3207

3466 (BMwF-FBK-68-33) RADIAL AND AXIAL DEVELOPMENT OF LIGHT EMISSION IN A SPARK CHANNEL BY MEANS OF A STREAK CAMERA. Koppitz, J. (Hamburg Univ. (West Germany). Institut fuer Angewandte Physik). July 1968. 28p. (In German). Dep.

The radial and axial development of the hot plasma spark channel is treated. The experiments were made with sparks generated in a homogeneous field under streamer conditions in hydrogen and nitrogen with a pressure of several hundred torr. The measured radial expansion is in good agreement with the theory of Braginskii, but not with that of Drabkina. A formula for the dependence of the channel radius on external parameters is derived. Axial inhomogeneities were found to be the consequence of an inhomogeneous development in the predischarge channel during the streamer stage. (auth)

3467 (NP-tr-1678) KINETIC EQUATION FOR ELEMENTARY EXCITATIONS AND NONLINEAR INTERACTIONS BETWEEN WAVES IN A PLASMA. Introduction and Contents. Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Culham Lab., Abingdon, Eng., from Preprint No. 12. 6p. (CTO-514). Dep. CFSTI, UK.

This review, which discusses the general questions of the theory and method of elementary excitations, also contains some results of applications of the theory to problems of plasma turbulence (turbulent heating, anomalous emission from a turbulent plasma, acceleration and statistical heating of plasma particles, ion heating, scattering of electromagnetic waves in a turbulent plasma and others). (auth)

3468 (SC-T-68-1542) CALCULATION METHOD OF THE DISPERSION RELATION OF A COLLISIONAL PLASMA. Lafleur, Charles (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from report CEA-R-3413. 9p. Dep. CFSTI.

An abstract for the original paper appeared previously in NSA 22: 24275. (M.O.W.)

3469 (UCRL-50002-68, pp 174-89) BASIC PLASMA AND ATOMIC RESEARCH. (California Univ., Berkeley. Lawrence Radiation Lab.).

Summaries of research are given for the following: (1) Homopolar Gun II, (2) cold microwave-plasma experiment, (3) steady state of a mirror plasma with external absorbing walls, (4) measurement of hf electric field in a plasma by observation of two-quantum transitions and spectral line shifts, (5) beam-plasma interaction experiment, (6) light scattering by a sheet pinch, (7) partially ionized plasmas, and (8) atomic cross sections. (M.O.W.)

3470 (UCRL-50496) RADIATION EMISSION RATES FOR A NONRELATIVISTIC GAS WITH INDEPENDENT ELECTRONS. Grasberger, William H. (California Univ., Livermore. Lawrence Radiation Lab.). Oct. 1, 1968. 15p. Dep. CFSTI.

The total radiation emission rate for a nonrelativistic gas with independent electrons for a nuclear charge Z, density ρ, and electron temperature T_e can be expressed by a formula identical to the bremsstrahlung emission rate formula, except that the free-free Gaunt factor is replaced by a generalized Gaunt factor. This generalized Gaunt factor is a function of the bound-state populations and the temperature. Results are given in graphical form of the generalized Gaunt factor for a plasma, where there are no bound-state populations, and for a gas in thermodynamic equilibrium. For the latter case, a scaling relation exists. The emission spectrum for a plasma is presented graphically for several values of the ratio of the ionization potential to the electron temperature. (auth)

3471 PARTITION FUNCTION OF A TWO-DIMENSIONAL PLASMA. Knorr, G. (Univ. of Iowa, Iowa City). Phys. Lett., 28A: 166-7(Nov. 4, 1968).

An elementary derivation of the exact equation of state of a two-dimensional classical plasma exhibits a condensation phenomenon at $T = T_c = e^2/4K$. It is shown that the partition function does no longer exist even if $T < 2T_c$. (auth)

3472 CURRENT PATTERN STABILIZATION IN PULSED PLASMA ACCELERATORS. Eckbreth, A. C.; Clark, K. E.; Jahn, R. G. (Princeton Univ., N. J.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2125-32(Nov. 1968).

Experimental maps of the magnetic field patterns throughout the exhaust plume of a pulsed plasma accelerator driven by a variable length and amplitude rectangular current waveform indicate that the familiar initial process of discrete current sheet propagation is followed by transition to a quasi-steady, more diffuse current conduction pattern. This steady phase, which typically is achieved some tens of microseconds after breakdown, displays essentially unchanged terminal voltage and current characteristics and continues to provide a stream of accelerated gas. The physical details of the transition from propagating to stationary current patterns in a discharge are more conveniently studied in a one-dimensional, parallel-plate configuration, where magnetic probe signatures, Kerr-cell photographs, and terminal voltage measurements again verify the stabilization effect. It is thus suggested that the "snow plow" sweeping process characteristic of any pulsed plasma accelerator is essentially a starting transient on the steady-flow acceleration mechanism for the same electrode geometry. (auth)

3473 RECOMBINATION AND DIFFUSION LOSSES IN NEGATIVE GLOWS. Emeleus, K. G. (Queen's Univ., Belfast). Phys. Lett., 28A: 115-16(Nov. 4, 1968).

In many negative glows, the electron temperature (T), concentration (n), and diffusion parameters adjust so that the main loss process is recombination, largely collisional-radiative, for n greater than some 5×10^{11} cm^{-3}, while diffusion loss predominates for n less than a small multiple of 10^{10} cm^{-3}. Control by collisional-radiative recombination implies partial thermal equilibrium of the electrons, ions, and excited states of the neutral particles at temperature T. (auth)

3474 SPECTROSCOPIC INVESTIGATION OF LOW-PRESSURE HOT-CATHODE DISCHARGE IN ARGON. Hoey, M. J.; Grimley, H. M.; Breslin, A. C. (University Coll., Dublin). Phys. Lett., 28A: 91-2(Nov. 4, 1968).

Neutral gas and ion kinetic temperatures in a low-voltage hot-cathode discharge in argon are reported and the dominant mechanism for excitation of the ion suggested. (auth)

3475 QUANTUM STATISTICS OF HIGH-TEMPERATURE PLASMAS IN THERMODYNAMIC EQUILIBRIUM. II. THE FREE ENERGY IN THE TEMPERATURE REGION FROM 10^6 TO 10^8 ^{0}K. Hoffmann, H. J.; Ebeling, W. (Univ., Rostock, Ger.). Beitr. Plasmaphys., 8: 43-56(1968). (In German).

The theory given in part I (Beitr. Plasmaphysik, 7: 233(1967)) is continued. In the region of temperatures and density, where the fundamental lengths of the plasma are ordered as $\lambda_{ii} < e^2/kT < \lambda_{ee}$ and where $n_e\lambda_{ee}^2 \ll 1$, quantum corrections to the classical Debye-Hückel free energy of an electron-ion-plasma are calculated explicitly. Here n_e is the electron density; λ_{ee} and λ_{ii} are the thermal wavelengths of the electrons and ions, respectively. The above assumptions are valid for temperatures between 10^6 and 10^{8} ^{0}K and electron densities $n_e < 10^{25}$ cm^{-3}. The effects of symmetry are taken into account. The relation between these results and those derived by DeWitt, Trubnikov and Elesin is discussed. (auth)

3476 ACCELERATION PROCESS IN A STABILIZED HIGH-CURRENT ARC. Burton, Rodney L.; Chang, Orson Yah-Shing (Univ. of California, San Diego, La Jolla). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2190-2(Nov. 1968).

Previous work on a pulsed parallel-plate accelerator has shown that the current pattern can be stabilized and the arc voltage increased by the introduction of insulation along the electrodes. Here experiments were performed to investigate the acceleration process in an insulated-electrode, parallel-plate arc. It is concluded that the arc is primarily accelerating electrode material. The experiments suggest that plasma acceleration is achieved

in the arc through a "pumping" effect, produced by j × B pinching and a resulting strong pressure gradient. (M.H.R.)

3477 STUDY OF MOVING STRIATIONS IN PLASMAS. III. THE FAST TYPE "r" AND THE DETERMINATION OF THE IONIZATION FREQUENCY DEPENDENCE ON THE ELECTRON MEAN ENERGY. Sicha, M.; Drouet, M. G. (Univ., Montreal). Can. J. Phys., 46: 2491-8(Nov. 15, 1968).

For ionization waves of small amplitude, the linearized equations of conservation for the particles and for the electron energy are applicable. A detailed study of these linearized equations reveals that the value of the ratio D_e/μ_e of the diffusion coefficient to the mobility for electrons and the derivative of the ionization frequency with respect to the electron mean energy α_i' may be determined from measurements of the phase difference between the variations of the electron temperature and the electron density in fast moving striations of the type "r." Some measurements are also reported and some values for D_e/μ_e and α_i' obtained. (auth) (Canada)

3478 PHOTON SCATTERING FROM QUANTUM PLASMAS. Schaibly, John Henry. Ann Arbor, Mich., Univ. of Michigan, 1968. 99p.

Thesis.

The cross section for scattering of photons from plasmas is derived by means of an application of quantum perturbation theory to a many-body system. Of special interest are two component, nonrelativistic, homogeneous, gaseous plasmas, although the generalization to other systems such as degenerate, charged particle liquids may in some cases be fruitful. The analysis formulates the cross section in the Born approximation relating it to multiple time correlation functions which are further analyzed within the context of the random phase approximation for systems in various field-free and magnetic field configurations. Corrections to the Thompson cross section resulting from the bound states in a magnetic field are also derived. The most important results obtained here are a systematic derivation of the dependence of photon scattering in plasmas on particle interactions in quantum systems immersed in a magnetic field, and the existence of Rayleigh-like scattering from the bound states existing in a magnetic field which is neglected in a classical theory. The primary effect of this additional scattering process is a depolarization of the incident radiation. (Disser. Abstr.)

3479 AN INVESTIGATION INTO THE DOWNSTREAM PLASMA STATE IN HYDROGEN PRODUCED BY AN ELECTROMAGNETIC COAXIAL SHOCK TUBE. Scott, Roderic MacDonald. Cleveland, Case Western Reserve Univ., 1967. 86p.

Thesis.

A series of investigations were carried out on an electromagnetic coaxial shock tube to improve the understanding of its performance. In these investigations the downstream plasma state was determined for a front traveling through unionized hydrogen at 3.85 cm/μsec. The resulting shock wave moved into a medium which had an initial gas pressure of 300 millitorr and an oblique bias magnetic field of about 19°. The measured post shock conditions were determined to be that the electron temperature was 6.0×10^4 °K, the density jump was 1.5, and the post shock azimuthal field was 2.6 kilogauss. These results were found to be at variance with available theories. The discrepancy was the worst for the temperature which was three to four times higher than the classical predictions. The anomaly is attributed to the onset of turbulence. Several suggestions based on the dynamics of the shock tube are made to extend the range of operation of this type of instrument. (Disser. Abstr.)

3480 AMPLITUDE AND PHASE DISTORTION OF A GAUSSIAN PULSE CARRIER PROPAGATING IN PLASMAS. Tuan, H. S. (State Univ. of New York, Stony Brook). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-16: 613-14 (Sept. 1968).

The behavior of transient signal propagation in lossless, isotropic, and homogeneous plasma is considered for a Gaussian pulse-moderated carrier. An approximate expression for the electric field is obtained. Both the amplitude change and the carrier-phase distortion are given in figures for various parameter values of interest. (auth)

3481 EXAMINATION OF THE IMPEDANCE-SHEET APPROXIMATION TO A PLASMA SLAB. Whitlow, W. L. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-16: 609-11(Sept. 1968).

The criteria associated with the use of an impedance-sheet approximation to a plasma slab are discussed for two cases. The first case considers plane-wave propagation through a plasma slab, and the second case considers a plasma-covered slot antenna terminated in a flat ground plane. Curves showing the percent deviation in the transmission loss between the impedance-sheet model and the plasma-slab model are presented for various plasma conditions. (auth)

3482 WAVES OF CHARGE DENSITY IN MODULATED BEAMS INTERACTING WITH PLASMA. Shapiro, V. D. Zh. Tekh. Fiz., 37: 1422-32(Aug. 1967). (In Russian).

The excitation of the Langmuir and ion-acoustic oscillations arising in a plasma during its interaction with a charge-density modulated nonenergetic beam was studied. The influence of beam modulation on the stability of the oscillations during arbitrary variation of the beam density was also studied. Calculations were based on hydrodynamic approximations. The only case considered is that of instabilities of excited oscillations when their wavelength is higher than that of the modulation. The spectra and growth rate of the oscillations are found, and it is shown that beam modulation substantially narrows the spectrum of unstable oscillations. In the case of nonhomogeneous beam density distribution, maxima of growth increments also decrease. Initiation conditions of parametric instabilities in a plasma-modulated beam system and the respective growth increments are also found. (ATD)

3483 POLARIZATION EFFECTS IN GENERATION AND RADIATION TRANSFER OF RELATIVISTIC ELECTRONS IN A MAGNETOACTIVE PLASMA. Sazonov, V. N.; Tsytovich, V. N. (Inst. of Theoretical Physics, Novosibirsk, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1287-99(1968). (In Russian).

The equation describing the polarization effects in generation and radiation transfer in a homogeneous anisotropic magnetoactive plasma is obtained. The equation is valid under the assumption of a weak anisotropy of plasma. The degree of anisotrophy of relativistic electrons is assumed to be arbitrary, however, the density of relativistic electrons is held to be much less than the plasma density. The equation derived takes into account the reabsorption effects associated with the processes of induced radiation and wave absorption (the negative reabsorption also), as well as the effects of spontaneous radiation. The intensity of circular polarization of spontaneous synchrotron radiation, estimated earlier only to the order of values, is calculated. For the negative reabsorption there occur the effects of induced polarization of radiation (primarily the radiation of one of polarizations). The possibility of primary amplification of the circularly polarized radiation under the condition of synchrotron instability associated with an anisotropic distribution of relativistic electrons is emphasized. (auth)

3484 STATIONARY WAVES IN A PLASMA WITH ELECTRIC FIELD. Fainshtein, S. M. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1300-8(1968). (In Russian).

The problem on stationary electrostatic waves in a collision ion-electron plasma with a constant electric field is considered. It is shown that at the definite conditions in a cold plasma, the solutions of the auto-oscillation type may be obtained. The amplitude of oscillations are determined by Van der Pol's method. In the plasma with thermal dispersion of electron velocities there may exist the solutions of auto-oscillation and shock-wave types. Investigation is made on the basis of quasi-hydrodynamic equations. (auth)

3485 SCATTERING OF A FUNDAMENTAL WAVE BY ELECTROMAGNETIC FLUCTUATIONS IN A RECTANGULAR WAVEGUIDE FILLED WITH PLASMA. Yakimenko, I. P.; Troitskii, S. V. (Kharkov Inst. of Radioelectronics). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 11: 1309-17(1968). (In Russian).

H_{10}-wave scattering cross-section due to fluctuations of the charge density in an isotropic plasma filling a rectangular waveguide is obtained. The processes of $H_{10} \rightarrow H_{m_0}$ type are considered. The cross sections of incoherent scattering of electromagnetic waves in a waveguide with plasma are calculated. (auth)

3486 FREQUENCY CONVERSION IN THE SHEATH CAPACITANCE OF A GLOW DISCHARGE PLASMA. Hilbish, R. T.; Montgomery, R. M.; Holmes, R. A. (Purdue Univ., West Lafayette, Ind.). J. Appl. Phys., 39: 5782-91(Nov. 1968).

A study is made of large-signal, high-frequency phenomena occurring in a slightly ionized plasma contained within a pair of metallic coaxial cylinders. An rf equivalent circuit is developed wherein the sheath is represented by a voltage-dependent capacitor in parallel with a voltage-dependent resistor, the presheath by a series resistor, and the plasma region by a series resistor and inductor. It is found that when the sheath is thin compared to the radius of the inner cylinder, the voltage dependence of the sheath capacitor reduces to a form identical with that of an abrupt junction varactor diode, so that the plasma capacitor is properly called a plasma varactor. As an application of the plasma varac-

tor, frequency doubling using standard semiconductor varactor techniques is attempted. The resultant peak conversion efficiency is found to be 31.6% at a drive frequency of 142 MHz and input power of 0.42 W. It is shown that the sheath conductance is responsible for this low conversion efficiency relative to that obtainable from a semiconductor varactor. (auth)

3487 EFFECT OF AN ACOUSTIC PULSE WAVE ON STRIATED NEON DISCHARGE PLASMA. Krejci, Vaclav (Inst. of Physics, Prague). J. Appl. Phys., 39: 5805-6(Nov. 1968).

A method for summarizing many oscillograms in one picture was used to study the interaction between acoustic pulses and ionization waves in Ne discharge plasma. The acoustic pulses were produced periodically, resulting in an instantaneous brightening of the whole discharge and an acoustic pulse propagating along the tube. Whenever the acoustic wave and ionization waves crossed, their amplitudes added. A set of derived ionization waves, with a fan-shaped structure, is produced with a velocity continuously varying from the acoustic pulse velocity to the optimum ionization wave velocity. The derived ionization waves were observed only when the acoustic wave propagated toward the anode. (D.L.C.)

3488 REABSORPTION OF SYNCHROTRON RADIATION. Bratman, V. L.; Suborov, E. V. (Groky State Univ., USSR). Zh. Eksp. Teor. Fiz., 55: 1415-22(1968). (In Russian).

Expressions for the increments of normal waves propagating at an arbitrary angle with respect to a stationary magnetic field are obtained by the kinetic equation method. The expressions are investigated for the case when a synchrotron instability arises in the "cold plasma + nonequilibrium electron" system. The difference between the normal wave increments is determined for quasi-longitudinal propagation. This difference may lead to an appreciable circular polarization of the synchrotron radiation for a sufficient size of the radiating region. (auth)

3489 LOCALIZED ELECTROMAGNETIC OSCILLATIONS IN A PLASMA. Alanakyan, Yu. P. (All-Union Inst. of Physico-Technical and Radiotechnical Measurements, Moscow). Zh. Eksp. Teor. Fiz., 55: 1338-43(1968). (In Russian).

It is shown that the equations of nonlinear electrodynamics in the two-dimensional case yield solutions which describe a circularly running wave. The wave field pressure in this case leads to the formation of a self-sustaining circular waveguide channel. The possibility of existence of localized electromagnetic oscillations with a toroid-like configuration in three-dimensional space is also discussed. (auth)

3490 SECOND VIRIAL COEFFICIENT OF A PLASMA. Kopyshev, V. P. Zh. Eksp. Teor. Fiz., 55: 1304-10(1968). (In Russian).

A general expression is derived for the second virial coefficient of a plasma at arbitrary temperature. It is shown that the Coulomb corrections to a perfect gas are restricted. For the pressure in light elements the maximal correction is of the order of 5%. (auth)

3491 KINETIC EQUATIONS IN THE THEORY OF A NORMAL CHARGED FERMI FLUID. Anokhin, S. B.; Kondrat'ev, A. S. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz., 55: 1356-66(1968). (In Russian).

Generalized kinetic equations are derived by the quantum Green function technique. The equations are employed for a microscopic foundation of the phenomenological theory of a degenerate Landau–Silin electron Fermi fluid. It is shown that in the case of a normal Fermi system and slowly varying external perturbations the phenomenological theory takes into account exactly correlation between the electrons. (auth)

3492 QUASI-dc PLASMA ACCELERATOR FOR INJECTING PLASMA INTO A TRANSVERSE MAGNETIC FIELD. Ashby, D. E. T. F. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys., 10: 665-72(July 1968).

A simple plasma accelerator that injects plasma across a magnetic field is described. The accelerator consists of two disk-shaped electrodes, 1 cm in diameter and placed 5 mm apart in the magnetic field of a long solenoid. The electrodes are oriented so that the current flow is perpendicular to the magnetic field with the magnetic force $j \times B$ directed away from the accelerator. A fast-acting gas valve, built into the anode, squirts hydrogen into the inter-electrode gap as a lumped parameter pulse line is discharged across the electrodes; a plasma stream is produced which crosses the magnetic field as well as spreading along the field lines. Typical operating conditions are: voltage drop 150 V, current 60 A, pulse time 100 μ sec, magnetic flux density 2 kG, ion energy 100 eV, total number of ions produced 6×10^{15}. A simplified accelerator has been made using electrodes of hydrogen loaded titanium; in this case the anode automatically dispenses hydrogen during the current pulse and the fast-acting gas valve is unnecessary. (auth)

3493 EXCITATION OF CYCLOTRON HARMONICS IN A PLASMA WITH ANISOTROPIC TEMPERATURE. Zayed, K. E.; Kitsenko, A. B. (Atomic Energy Establishment, Cairo). Plasma Phys., 10: 673-80(July 1968).

The effect of an anisotropy of the velocity distribution function upon the spectrum of plasma oscillations was investigated. It has been shown that excitation of harmonics of electron cyclotron frequency may occur not only for longitudinal oscillations but also for transverse electromagnetic waves, easily radiated from the plasma. (auth) (UK)

3494 INVERSE THIRD POWER LAW FOR THE SHIELDING OF TEST PARTICLES. Montgomery, D.; Joyce, G.; Sughara, Ryo (Oak Ridge National Lab., Tenn.). Plasma Phys., 10: 681-6(July 1968).

It is shown that the effective potential of a "test charge" in a Vlasov plasma falls off, in general, as the inverse third power of the distance of the observer from the test charge, at large distances. The law applies when earlier the test charge is in motion relative to the plasma, or the plasma is anisotropic. Only when the test charge is at rest in an isotropic plasma does the exponential Debye factor appear in the effective potential. (auth) (UK)

3495 MULTIMOMENTUM 650-mA ION SOURCE. Hamilton, G. W.; Hilton, J. L.; Luce, J. S. (Aerojet-General Corp., San Ramon, Calif.). Plasma Phys., 10: 687-97(July 1968).

A high-current well-focused multimomentum source of molecular ions was developed as part of a high-energy energy-spread injection system. The multimomentum injection system is designed to produce a trapped plasma with continuous distributions of momenta and energies in order to reduce velocity-space instabilities. The ion source beam was delivered at 16 to 20 keV, and was composed of nine or more different species of molecular and atomic ions of hydrogen, deuterium, and other gases, which were extracted and focused identically and simultaneously. Maximum beam divergence was 2° from the beam axis. Average beam intensity was 130 mA/cm^2 in a 2-cm-dia beam, 40 cm from the source. Electrostatic focusing was accomplished by an array of 6-mm-dia "accel-decel" extraction and focusing apertures. The beam was 85% composed of molecular ions, of which either the diatomic or triatomic component could be maximized by an adjustment of the gas fed to a reflex arc. Operating with a mixture of hydrogen and deuterium gas, the relative intensities of the several mass-to-charge ratio beam components indicated a random distribution of protons and deuterons. (auth)

3496 OSCILLATIONS OF BOUNDED BEAM–PLASMA SYSTEMS IN A CYLINDRICAL GEOMETRY. Shoucri, M. M.; Kitsenko, A. B. (Atomic Energy Establishment, Cairo). Plasma Phys., 10: 699-711(July 1968).

The small-amplitude oscillations in bounded beam–plasma systems with a sharp interface between two plasma media were investigated. The dynamic character of the electromagnetic wave field was taken into account, which made it possible to proceed beyond the quasi-static approximation usually employed. The space charge and current of the beam travelling along the external magnetic field were assumed to be compensated. The thermal motion of plasma and beam particles was neglected. Oscillation frequency and growth rates were found for "whistlers" and waves corresponding to the quasi-static approximation in a cylindrical plasma waveguide with a low density beam moving near the axis. (auth) (UK)

3497 EFFECT OF PLASMA AND MAGNETIC FIELD INHOMOGENEITIES ON PARTICLE ACCELERATION BY BEAM INSTABILITIES. Preinhaelter, J. (Inst. of Plasma Physics, Prague). Plasma Phys., 10: 713-27(July 1968).

It is demonstrated that waves excited by a beam of electrons in a cold collisionless magnetoactive plasma can be absorbed in the inhomogeneous region of the system. Absorption takes place in the neighborhood of the resonance of the excited wave frequency with the plasma frequency ω_o, cyclotron frequency ω_c (when the inhomogeneity is in the direction of the external magnetic field) or hybrid frequency $\Omega = \sqrt{(\omega_o^2 + \omega_c^2)}$ (when the inhomogeneity is transverse to the magnetic field). The particle acceleration that results occurs in the direction of the magnetic field (plasma resonance) and in the transverse direction (cyclotron and hybrid resonances). In addition to being absorbed, the waves are also reflected (in regions of hybrid resonance with a longitudinal inhomogeneity of the system and in regions of cyclotron and plasma resonance with a transverse inhomogeneity of the system. (auth) (UK)

3498 CALCULATING THE AMPLIFICATION IN AN ELECTRON BEAM–PLASMA SYSTEM. Rogashkova, A. I.; Tseitlin, M. B. Radiotekh. Elektron., 13: 1324-6(July 1968). (In Russian).

It is known that two types of interactions which lead to amplification of the uhf signal exist in an electron beam–plasma system: (a) interaction of the electron beam with the slow electromagnetic wave in the wave guide, and (b) the interaction of the modulated electron beam with induced charges in the fixed medium. It can be shown that both types of interaction can exist simultaneously and have an effect on each other. An equation of the fourth degree with respect to the propagation constant γ is derived, and from this equation an expression is obtained for the amplification factor C. The depression of the field due to the space charge is taken into account. The amplification is plotted as a function of the frequency. (TTT)

3499 EFFECTIVE ELECTRON MOBILITY IN A TRANSVERSE MAGNETIC FIELD. Brzhezitskii, V. A. (Inst. of Electrodynamics, Moscow). Teplofiz. Vys. Temp., 6: 917-9(Sept.-Oct. 1968). (In Russian).

The influence of the law of real electron scattering, during collisions with heavy particles, on the properties of plasma mobility in a transverse magnetic field was studied. The studies were confined to the case of a Lawrence gas in which the electron–electron collision frequency was small in comparison to the frequency of electron collisions with heavy plasma particles. A precise linearized Boltzmann equction for electrons was used in the studies. Reduced effective electron transport in a weakly ionized argon plasma in a transverse magnetic field was analyzed as a function of various electron temperatures. (R.V.J.)

3500 SIMPLE MODEL OF THE COAXIAL PLASMA GUN WITH POSITIVE CENTRAL ELECTRODE. Pert, G. J. (Univ. of Alberta, Edmonton). J. Phys., D (London), 1: 1487-93(Nov. 1968).

A simple fluid model of the operation of a large annulus ratio coaxial electromagnetic gun is presented. The profile of a stable steady-state front driven by the electromagnetic forces is calculated and shown to be in reasonable agreement with experimental results for such a device operated with the central electrode positive. The plasma state in the flowing gas layer in the front is discussed. (auth) (UK)

3501 SOLID-ANGLE INTEGRATION OF nTH-STAGE TENSORS FORMED BY TENSOR MULTIPLICATION FROM UNIT VECTORS IN THE KINETIC THEORY OF LORENTZ PLASMAS. Wilhelm, J.; Winkler, R. (Institut fuer Gasentladungsphysik, Greifswald, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 10: 112-17(1968). (In German).

In the tensor treatment of the collision integral development, the knowledge of the solid-angle integration extending over the total solid angle is necessary for nth-stage tensors constructed by general tensor multiplication from a unit vector randomly varying about a fixed point. The calculation on this integral for any selected tensor stage is explicitly given. (tr-auth)

3502 MEASUREMENT OF THE ELECTRIC CONDUCTIVITY TRANSVERSE TO A MAGNETIC FIELD OF SHOCK-IONIZED AIR. Cottereau, Marie-Joseph; Valentin, Pierre (Laboratoire de Thermodynamique, Rouen). Compt. Rend., Ser. A and B, 267: 440-3(Aug. 12, 1968). (In French).

A method previously described (P. Valentin and M. J. Cottereau, Compt. Rend., 264: Ser. B, 130(1967)) was adapted to the measurement of the conductivity, transverse to a magnetic field, of air ionized by collisions (initial pressure of 1 torr). The variation of this conductivity with the induction permits an evaluation of the electron collision frequency. (tr-auth)

3503 WHIRL STABILIZATION OF CYLINDRICAL ELECTRIC ARCS. Krichel, R.; Druxes, H.; Schmitz, G. (Technische Hochschule, Aachen). Z. Phys., 217: 336-49(1968). (In German).

In contrast to well-known cylindrical, whirl-stabilized electric arcs with rotating walls or with nearly tangential gas inlets, a new geometry of an electric arc for producing a whirl around the axis is discussed. These investigations have been performed for transferring the theory to a torus arc in a similar way. By using a numerically calculated temperature distribution the hydrodynamic properties are studied taking into consideration the single-fluid model of plasma physics. The results are compared with the authors' experiments and those of other institutes. They agree well and give hope for a stabilizing effect for an electric arc of this geometry. The analytical distributions of the velocities and the pressure are calculated on the basis of perturbation theory. The results are applied to a nitrogen arc at a pressure of one atmosphere and for a definite set of parameters. (auth)

3504 DISPERSION RELATIONS OF THE SURFACE PLASMA OSCILLATIONS OF MULTILAYERS. Shieh, Shuang-yuan (Lehigh Univ., Bethlehem, Pa.). Z. Phys., 217: 406-8(1968).

An equation for determining the dispersion relations of the surface plasma oscillations has been derived for the most general case of multilayers. The equation is given in a very simple form of the vanishing of the trace of a product of 2×2 matrices of recursive type. (auth)

3505 PLASMA OSCILLATION EFFECTS ON ELECTRON DENSITY AND TEMPERATURE. Zvereva, F. G.; Shcheglov, O. S. (Kuibyshev State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 8, 158-60(1968). (In Russian).

Excitation of high-frequency plasma oscillations by a nonmodulated electron beam was studied using a 40-mm-dia. cylindrical glass tube with tungsten spiral wire cathode and a moving 30-mm disc tantalum anode placed 0 to 160 mm from each other. The intensity and frequency of oscillations as functions of the probe position in the discharge were studied at a discharge current of 100 mA, tube voltage of 35 V, anode–cathode spacing of 30 mm, and pressure of 0.304 m torr. (R.V.J.)

3506 DECELERATION OF CONDUCTING CLUSTERS MOVING ALONG A CHANNEL IN A NON-HOMOGENEOUS MAGNETIC FIELD. Vatazhin, A. B. Prikl. Mat. Mekh., 32: 869-81(Sept.-Oct. 1968). (In Russian).

Studies were made of plasma cluster deceleration in channels with all walls nonconducting or with two ideally conducting areas connected by an external load. Under such conditions the kinetic energy of the clusters transforms into Joule heat and electric energy which are transferred to the load. Formation of closed vortex currents in the cluster result in deceleration of the cluster. The studies were confined to the problems of the dynamics of the cluster delay in conditions similar to those taking place in electric-discharge installations and in installations for pulsed power production from low-conductivity gas. (R.V.J.)

3507 COUPLING OF WHISTLE MODE AND ACOUSTIC WAVES IN A HIGH PRESSURE PLASMA. Kondratenko, A. N.; Stepanov, K. N. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 13: 1515-21(Sept. 1968). (In Russian).

The coupling of whistler mode and ion–acoustic oscillations in a nonisothermal plasma with hot electrons and cold ions is considered in case when plasma pressure is much higher than the magnetic one. Frequencies, attenuation coefficients, and polarization of coupled waves are obtained. (auth)

3508 SOME REMARKS ON SPACE-CHARGE ACCELERATION OF A PLASMA IN AN AXIALLY NONUNIFORM MAGNETIC FIELD. Caldirola, P. (Univ., Milan. CNR, Milan). Nuovo Cim., 58B: 372-5(Nov. 11, 1968).

A simple theory is presented to explain the main features of a plasma beam accelerated in a nonuniform axial magnetic field. Using a Lisitano coil as plasma source, the radiation field outside the coil is assumed to be zero. (M.O.W.)

3509 ABSORPTION OF AN EXTRAORDINARY WAVE IN THE REGION OF HYBRID RESONANCE OF A WEAKLY IONIZED NONUNIFORM PLASMA. Omel'chenko, A. Ya.; Stepanov, K. N. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 13: 1522-6(Sept. 1968). (In Russian).

The behavior of an electromagnetic extraordinary wave in a resonant layer of a weakly ionized nonuniform plasma where wave frequency is equal to the hybrid one is considered at normal incidence of the wave on a semi-infinite plasma. The coefficient of wave absorption is determined in case of a weak magnetic field, when distance between the reflection point and hybrid resonance one is considerably less than the wavelength. The field behavior is determined in a resonant region with spatial dispersion when the collision frequency is small, and the generation of plasma waves should be taken into account. (auth)

3510 SEMIAUTOMATIC APPARATUS FOR THE INVESTIGATION OF GAS-DISCHARGE PLASMA IN MAGNETIC FIELDS. Levshuk, L. A. (Tomsk Inst. of Radioelectronics and Electronic Tech., USSR). Prib. Tekh. Eksp., No. 4, 169-71 (July-Aug. 1968). (In Russian).

Apparatus is described for automatic recording of the main quantities which characterize the properties of gas discharge upon its supply from stabilized sources of current or voltage. (tr-auth)

3511 SURFACE WAVES ON INHOMOGENEOUS PLASMA COLUMNS. Ilic, D. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Int. J. Electron., 24: 439-52(May 1968).

Quasi-static theory is presented for axially symmetric and dipolar surface modes propagating down an inhomogeneous plasma column enclosed in a glass tube surrounded by free space. The

effect of a sheath with no electrons present, radial parabolic electron density distribution, and the combination of these two effects on the dispersion relations of the axially symmetric and the dipolar modes is investigated for lossless, cold, and isotropic plasma. Parabolic density variation is treated approximately by a variational technique. Dispersion relations for all three examples of inhomogeneity for both the n = 0 and n = 1 modes are calculated for a wide variety of parameters of inhomogeneity. The dipolar mode is seen to be more sensitive to inhomogeneous electron density distribution than the axially symmetric mode for small $\beta\alpha$ (β = propagation constant; α = parabola parameter) and is thus better suited for experimental verifications than the axially symmetric mode. (auth) (UK)

3512 ON A THEORY OF STATIONARY LAYER STRUCTURE IN A GAS DISCHARGE (INVESTIGATION OF PERIODIC SOLUTIONS OF THE SYSTEM OF PLASMA NONLINEAR EQUATIONS USING ANALOGUE COMPUTER). Chapnik, I. M. Radiotekh. Elektron., 13: 1085-91(June 1968). (In Russian).

An analog computer was used to obtain the solution of a system of nonlinear equations describing a positive column plasma. The solution is shown to be periodic, with increasing or decreasing amplitude. The period of oscillations agrees with experimental observations. The damping coefficient is determined from the relation of the electron mean free path and the average energy lost upon electron collision, and also in certain cases, from initial conditions. The main processes that determine the emergence of the stationary layer structure are: thermal diffusion of electrons and the ionization of molecules of the gas by electron impact. If one excludes from the equations of the plasma those terms that consider the thermal diffusion of the electrons, then the periodic solution does not exist. (tr-auth)

Production

3513 (NP-17674) SUPERHIGH-FREQUENCY GENERATION OF STRONGLY IONIZED ARGON PLASMA. Anisimov, A. I.; Vinogradov, N. I.; Golant, V. E.; Nanobashvili, S. I.; Pakhomov, L. P. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1968. 8p. (In Russian). Dep.

An argon-filled cylinder with initial pressure of 5×10^{-4} to 5×10^{-2} mm Hg was used along with two sources, one with pulse duration of 1 sec and 200-W energy and the other with 20-μsec pulse duration and 20 kW energy. In the range studied ($p = 5 \times 10^{-4}$ to 5×10^{-2} mm Hg) the pulse duration exceeded considerably the time interval between ionization collisions. Graphical data obtained for various superhigh-energy levels showed that at the specific energy near 150 W. cm^{-3} and at pressures less than 10^{-3} mm Hg it is possible to obtain plasma densities of 10^{13} to 5×10^{13} cm^{-3}, electron energy 6 to 10 eV, and almost complete ionization. (R.V.J.)

3514 (SC-RR-68-218) SURFACE IONIZATION OF ARGON OBSERVED IN PLASMAJET TESTS. Shipley, K. L. (Sandia Corp., Albuquerque, N. Mex.). May 1968. Contract AT(29-1)-789. 17p. Dep. CFSTI.

Spectral lines of ionized argon appear to be emitted from the surface of a tungsten body immersed in a supersonic argon plasma jet. The intensity of this spectrum and the temperature derived from a Boltzmann plot are unusually high. (auth)

3515 ON THE FORWARD MOTION OF BOSTICK PLASMOIDS. Butter, D. A. (General Electric Co., Cleveland). Phys. Lett., 28A: 138-9(Nov. 4, 1968).

A theoretical interpretation is offered of the experimental observation that the velocity of Bostick plasmoids in vacuo, directly away from a button source, depends only upon the energy of the source capacitors in the button gun circuit. (auth)

3516 NUMERICAL CALCULATIONS OF THE DYNAMICS OF LASER-PRODUCED PLASMAS. Mulser, P.; Witkowski, S. (Institut fuer Plasmaphysik, Munich). Phys. Lett., 28A: 151-2 (Nov. 4, 1968).

Numerical results are presented for the production of a plasma by laser irradiation of solid H_2 and its motion in a one-dimensional geometry. (auth)

3517 EXPANSION IN A MAGNETIC FIELD OF A PLASMA CREATED BY LASER IRRADIATION OF A SOLID. Bruneteau, J.; Fabre, E.; Lamain, H.; Vasseur, P. (CNRS, Paris). Phys. Lett., 28A: 84-5(Nov. 4, 1968). (In French).

Similar total charge quantity in a laser-produced plasma are measured for foil thicknesses of 1 and 6 μ. In a 7 Wb/m^2 magnetic field the transverse expansion of the plasma is lowered and the plasma boundary density reaches 10^{17} e/cm^3. (auth)

3518 HEAT TRANSFER BETWEEN AN ELECTRIC ARC COLUMN AND A WALL OF DISCHARGE CHAMBER IN A VORTEX LINEAR PLASMA GENERATOR. Zhidovich, A. I.; Kravchenko, S. K.; Yas'ko, O. I. (Inst. of Heat- and Mass-Exchange, Minsk). Inzh.-Fiz. Zh., 15: 392-9(Sept. 1968). (In Russian).

Generalized arguments are found on the basis of the analysis of the energy balance of insulation inserted in the plasma generator. With the use of the generalized arguments the heat fluxes of the metal in the vortex generator with bilateral outflow are correlated in dimensional sets. It is found experimentally that the arc affects considerably the development of the flow turbulence and for the conditions of developed turbulence, the Reynolds number (Re) is eliminated from the generalized arguments. (auth)

3519 PREPARATION OF FAST NEUTRONS BY MEANS OF AUTOION EMISSION AND SURFACE IONIZATION OF DEUTERIUM IN STRONG ELECTRIC FIELDS. Tarasova, L. V.; Khudyakova, L. N.; Shutov, V. V. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 8, 145-7(1968). (In Russian).

Various types of gas discharge with ions produced by shock ionization are used as ion sources in D–T reaction fast neutron generators. Deuterium ionization for the D–T reaction produced by autoionization and surface ionization in strong electric field was studied. Autoionization in high-voltage fields by the tunnel effect was used previously in ion projectors. The curves of the total flux and neutron yield as functions of the target intensity and temperature (950°C) of the platinum anode are analyzed. (R.V.J.)

3520 ANALYSIS OF MPD ARCS WITH NONEQUILIBRIUM IONIZATION. Seals, R. K. Jr.; Hassan, H. A. (North Carolina State Univ., Raleigh). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2273-8(Dec. 1968).

A quasi-one-dimensional analysis of the MPD arc which takes into consideration finite rate processes and allows for a variable area is presented. Starting from low subsonic velocities at the entrance, the governing equations are integrated through the transonic region into the supersonic region for an argon propellant at low mass flow rates. The results show that the electron temperature is well predicted by the theory; however, calculated velocities are roughly half the measured values. The current densities peak in the neighborhood of the cathode tip, and they do not exhibit any unusual features in the transonic region. Comparison of calculated and measured power inputs led to the conclusion that most of the published data are taken in situations where transition to supersonic velocities takes place outside the engine; in such situations, the possibility of gas entrainment exists and the effective and metered mass flow rates are not necessarily equal. It is further concluded that a three-dimensional analysis is needed to reconcile discrepancies between theory and experiment. (auth)

3521 EXPERIMENTS ON THE FIELD CONFIGURATION AND A STABLE CONDITION OF PLASMA IN PIG DISCHARGE TUBE. Kuroda, Tsutomu (Nagoya Univ., Japan). Jap. J. Appl. Phys., 7: 1528-33(Dec. 1968).

The noises of plasma in PIG discharge were studied under the various kinds of the magnetic field configuration, i.e., the cusp field, the mirror field, and divertor-type field. The frequency spectrum of the anode voltage fluctuation and the plasma densities were measured. A stable and optimum discharge condition as a plasma source is obtained in a divertor-type field. In such a field, not only the plasma noise amplitudes are minimized and are one fiftieth as large as those in the uniform field, but also the plasma density becomes much greater than that in other field configurations. (auth)

Stability

3522 (CERN-Trans-68-6) ON THE NON-LINEAR THEORY OF A HYDRODYNAMIC BEAM INSTABILITY. II. Makhan'kov, V. G.; Shichinov, B. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by B. Hodge and revised by N. Mouravieff (CERN, Geneva), from report JINR-P9-3690. 8p. Dep. CFSTI.

An abstract for the original paper appeared previously in NSA 22: 19964. (M.O.W.)

3523 (MATT-Trans-54) FLUTE INSTABILITY OF A CURVILINEAR PLASMA COLUMN WITH A CURRENT. Shafranov, V. D. Translated for Princeton Univ., N. J., from report IAE-1351. 45p. Dep. CFSTI.

A generalization of the Suydam criterion is obtained for an arbitrary curved plasma column. As a special case of the criterion, the known results of Mercier on local stability of a plasma in the vicinity of a magnetic axis are discussed. In a curved

plasma column, along with the stabilizing effect of the shear of the magnetic lines of force, the stabilizing role of the magnetic well becomes significant. The occurrence of a magnetic well is caused by shifting of the magnetic axis into the region of a weak toroidal magnetic field. The part of the shift which is related to the balloon effect of the plasma column as a whole contributes to the magnetic well, in particular, compensating for the balloon mode of instability. The other part of the shift caused by electrodynamic stretching of the current column creates a vacuum magnetic well which does not depend on the plasma pressure. In the stability criterion the stabilizing role of the vacuum magnetic well is manifested in the occurrence of the coefficient F, which depends both on the average curvature of the column and on its harmonics. The condition of stabilization by the magnetic well, $F > 1$, imposes restrictions on the "stability reserve coefficient" $q = 2\pi r B_s(r)/LB_\theta$. This work contains an investigation of the ranges of variation of the values of q ensuring stability for systems of the racetrack type and also spatial figure eights. (auth)

3524 (MATT-Trans-67) STABILITY OF OSCILLATIONS OF TRAPPED PARTICLES WHEN PLASMA QUASINEUTRALITY IS DISTURBED. Rosinskii, S. E.; Rukhlin, V. G. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Plasma Physics Lab., Princeton Univ., N. J., from Preprint No. 105. 35p. Dep. CFSTI.

The effect of stabilizing an instability in trapped particles by an electric field arising on departure of the plasma from quasi neutrality is studied in the example of a direct double (helix) magnetic field with helical symmetry. It is demonstated that electric fields arising in real installations as a result of withdrawal of ions to the chamber walls stabilize the known flute instability in trapped particles if the electric drift velocity v_{E_θ} becomes comparable to or greater than $v_{Ti}\, 2\pi r/L_{wind}$ (r is the plasma radius and L_{wind} is the spacing of the current winding). Lower-frequency disturbances with frequencies below the magnetic drift frequency are stabilized by smaller electric fields. In addition, a new instability has been found arising from the centrifugal drift of trapped particles in an electric field analogous to the known gravitational instability. This instability appears for exactly those electric fields for which stabilization of flute disturbances in trapped particles occurs; therefore, it is the most dangerous instability in plasma with an uncompensated charge. (auth)

3525 (NP-17656) STABILITY OF INHOMOGENEOUS HOT PLASMA FLOW. Preprint No. 89. Baikov, I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 14p. (In Russian). Dep.

The kinetic theory of steady laminar flow of inhomogeneous plasma along a magnetic field is discussed. It is shown that under phase resonance conditions, between the rate of the flow and the acoustic or drift wave, new instabilities appear in plasma caused by the flow rate gradient. The instability increment can exceed considerably the frequencies of plasma drift oscillations. (tr-auth)

3526 SUPPRESSION OF PLASMA ION OSCILLATIONS BY ELECTRON PLASMA OSCILLATIONS. Kawai, Y.; Kawabe, T.; Takayama, K. (Nagoya Univ., Japan). Phys. Lett., 28A: 125-6(Nov. 4, 1968).

An experiment was conducted on a homogeneous plasma produced by an electron beam in argon. It is observed that plasma ion oscillations are suppressed by intensified electron plasma oscillations. (D.L.C.)

3527 THE HALL EFFECT AND KELVIN-HELMHOLTZ INSTABILITY IN A PLASMA. Sen, Amiya K.; Chou, Chih Kang (Columbia Univ., New York). Can. J. Phys., 46: 2557-62(1968).

It is shown that a new unstable mode due to the Hall effect appears in the Kelvin–Helmholtz problem in an ideal plasma. The instability appears whether or not the Kelvin–Helmholtz discontinuity is stable or unstable in the absence of a Hall current. An upper bound on the growth rate of the Hall instability is found to be of the order of the ion cyclotron frequency. (auth) (Canada)

3528 THERMODYNAMIC STABILITY OF A PLASMA WITH STRONG INTERACTION. Klyuchnikov, N. I.; Triger, S. A. (Inst. of High Temperature, Moscow). Zh. Eksp. Teor. Fiz., 55: 1248-52(1968). (In Russian).

The thermodynamic stability of a classical system of charged particles with strong interaction is considered. An investigation of various types of disturbances leads to the conclusion that such a system cannot simultaneously be stable with respect to all types of fluctuations. The regions of stability with respect to various types of fluctuations are indicated. (auth)

3529 INSTABILITY OF A PLASMA DRIFTING ACROSS A MAGNETIC FIELD. Watanabe, Tsuguhiro; Midzuno, Yukio (Nagoya Univ., Japan). J. Phys. Soc. Jap., 25: 1156-61(Oct. 1968).

Longitudinal waves propagating across a magnetic field are studied theoretically. It is assumed that electrons and ions of the plasma have shifted Maxwellian velocity distributions with mean velocities perpendicular to the magnetic field and different from each other. The minimum relative velocity between electrons and ions for the onset of an instability is obtained in terms of collision frequencies and other parameters. The wave number k of the wave excited at the minimum relative velocity V_{min} is given by $kV_{min} \approx \omega_{ce}$ (electron cyclotron frequency) and the corresponding frequency is $\omega \approx kv_{iT}$ (v_{iT} is ion thermal velocity) in the rest frame of ions. Some numerical analyses are made to confirm the conclusions and to show the characteristic harmonic structure of frequency spectra. (auth)

3530 MAGNETIC DRIFT INSTABILITY IN A COLLISIONLESS PLASMA. Pogutse, O. P. (Inst. of Atomic Energy, Moscow). Plasma Phys., 10: 649-64(July 1968).

The stability of plasma in a toroidal system is investigated for drift type oscillations which have phase velocities in the range $v_{Tc} \gg \omega/|k_\parallel| \gg v_{Ti}$. It is shown that both ion and electron magnetic drift instabilities can exist. When joule heating is present, and when the electron temperature considerably exceeds the ion temperature, only the electron instability is excited. The influence of corrugation of the field is also considered; it is shown to be unimportant in the presence of high shear. For low shear, and in the presence of a temperature gradient, corrugation does not stabilize the oscillations. (UK)

3531 GRAVITATIONAL INSTABILITY WITH HALL EFFECT IN PLASMA. Sen, Amiya K.; Chou, Chih Kang (Columbia Univ., New York). Can. J. Phys., 46: 2553-6(Nov. 15, 1968).

It is shown that the new modes introduced by the inclusion of the Hall effect in the gravitational stability problem of a plasma are stable. However, an old mode (which is stable in the absence of a Hall current) becomes unstable. We conclude that the Hall current has a destabilizing effect and that the Jeans criterion for stability is adversely affected by its presence. However, the growth rate of the Hall instability is found to be negligible for any astrophysical system. (auth) (Canada)

Shielding

Refer also to abstracts 3903, 3909, and 3919.

3532 (AD-670479) GAMMA-RAY PULSE-HEIGHT SPECTRA: FORMATION OF A RESPONSE MATRIX FOR ITERATIVE UNFOLDING. Sam, Daniel; Bunney, Leland R.; Heater, Drexel C. (Naval Radiological Defense Lab., San Francisco, Calif.). Nov. 20, 1967. 45p. (USNRDL-TR-68-47). CFSTI.

The gamma-ray spectra of fission products resulting from nuclear weapon detonations provide basic data required in fallout exposure and shielding calculations. One method for obtaining the gamma-ray spectra is the application of the iterative unfolding technique to the measured pulse-height spectra. This technique, however, requires the construction of a response matrix which contains a series of response functions of the detector assembly to various gamma-ray energies. This report describes the essential steps in the construction of a response matrix, having the dimensions 100 energy bins and 1024 channels, used to obtain the complex gamma-ray spectra from the experimental pulse-height spectra. The photons of interest have an energy range extending from 0.060 to 5.00 MeV. The report also presents the associated computer programs for generating and using the response matrix. The results of unfolding of synthesized pulse-height spectra having a known number of gamma rays of known energy are presented. The computer programs are written in Fortran II language for use with an IBM-704 computer. (auth) (USGRDR)

3533 (ARH-46) DOSE RATES FOR CYLINDRICAL SOURCE VOLUMES FROM FREQUENTLY ENCOUNTERED FISSION PRODUCTS THROUGH LEAD, IRON, AND CONCRETE. Moulthrop, H. A.; Vladimiroff, D. T. (Atlantic Richfield Hanford Co., Richland, Wash.). July 1968. Contract AT(45-1)-2130. 71p. Dep. CFSTI.

Gamma dose rates, including bremsstrahlung, derived by use of the ISOSHLD Computer Codes I and II are presented for a series of twelve cylindrical vessels of graduated sizes containing an aqueous solution for each of ten common fission product sources. Through the use of tables and charts included herein, each of these 120 combinations of source and vessel geometry are

further related to shielding materials of lead, iron, concrete, and plastic. The calculations include eighteen different shielding arrangements from which dose rates versus shielding thicknesses are plotted. The graphs as developed from these data are presented for each of the ten isotope sources. Volumes for which dose rate data are given vary from one milliliter to 15,600 gallons. Dose rates with iron and lead shielding are calculated for a 3-foot distance from the near side of the vessel and those with concrete are for 10 feet. Graphs are also presented for determining the dose rate at other distances and for interpolating dose rates for process vessels of intermediate volumes. (auth)

3534 (BNWL-871) PLUTONIUM DIOXIDE GAMMA ATTENUATION MEASUREMENTS THROUGH STEEL. Brackenbush, L. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1968. Contract AT(45-1)-1830. 16p. Dep. CFSTI.

Photon dose-rates and energy spectra of two plutonium dioxide samples were measured, and attenuation measurements made with thin stainless steel absorbers. Relatively low exposure (~10% ^{240}Pu) and high exposure (~23% ^{240}Pu) plutonium samples were used. The surface dose rates from the two samples measured through plastic bags were 1.7 rad/hr and 4.6 rad/hr; the dose rates were reduced to 0.55 rad/hr and 1.55 rad/hr; respectively, by 0.020 inches of steel. Spectral measurements show 0.020 inches of steel eliminates most of the activity below 30 keV and appreciably attenuates the activity below 60 keV. Transmission ratios for a pure ^{241}Am source through steel absorbers are also presented. (auth)

3535 (ORNL-tr-1814) ON SOME PROBLEMS OF RADIATION PROTECTION IN COSMIC FLIGHTS. [PART] II. Swart, H. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Astron. Raumfahrt, 5: No. 1, 23-32(1967). 12p. Dep. CFSTI.

Radiation protection in a charged particle environment on space missions is considered. Data are given on solar cosmic radiation, and event probability and intensity decay factors are analyzed. The total radiation dose due to solar radiation is considered, with special attention given to questions of proton dosages acceptable to manned space crews protected by various shielding systems. Dosage tables are included. Cosmic solar radiation, with the danger of attendant proton showers, is the principal danger in deep space. The extent and intensity of Earth's radiation belts are reviewed, their relation to solar activity periodicity is analyzed, and their contribution to the general radiological conditions is investigated. The screening effect of specific materials is mentioned. A brief discussion is given on artificially generated radiation belts. (ATD)

3536 (ORNL-tr-1848) PROPAGATION OF THERMAL NEUTRONS IN MOCK-UP HELICAL STEEL INSERTS IN A WATER SHIELD. Devillers, Christian; Lanore, Jeanne-Marie (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-R-3196. 48p. Dep. CFSTI.

An abstract for the original paper appeared previously in NSA 21: 35208. (M.O.W.)

3537 (ORNL-tr-1869) A METHOD FOR THE MEASUREMENT OF INCREMENT FACTORS FOR GAMMA RADIATION IN THE ENERGY REGION OF 0.5 TO 15 MeV. Futtermenger, W. (Technische Hochschule, Hanover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz). Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from report ABS-THH-1019. 83p. Dep. CFSTI.

A principle of measurement is described which permits determining the dose and energy absorption increment factors for gamma rays in the region of energy from 0.5 to 15 MeV required in calculation of shielding. The apparatus for measurement avoids large radiation fields. A narrow circled-down beam penetrates a model of the shield. The spectrum of the issuing gamma radiation is measured separately in the beam and in the field of lateral scattered radiation. From the two components, increment factors can be derived. With an electron accelerator for heterochromatic radiation and a sodium iodide scintillation crystal as detector, high sensitivities can be achieved and thereby large laminar thicknesses investigated. From the variation of the maximal energy of the applied heterochromatic gamma radiation increment factors for monoenergetic radiation can be obtained. The procedure was tested with iron as shielding material, so that a comparison with the known theoretical increment factors for iron could be made. The increment factors obtained in all cases lie within the limits of error of these comparative values. In a further series of experiments the hitherto unknown dose increment factors of a barite concrete were determined. (auth)

3538 (ORNL-tr-1878) INSTRUCTIONS FOR THE USE OF COMPUTER PROGRAMS AVAILABLE TO THE WORKING GROUP IN CONSTRUCTION ENGINEERING FOR RADIATION SHIELDING. III. CDC 1604 A: MAC-RAD, GAMMONE, PHOEBE, SCD, 05R. LGP 21: TESIW, PIP, ZIP, LLG. Sasse, S.; Schubart, H.; Vogt, H. G.; Wueneke, C. D. Translated for Oak Ridge National Lab., Tenn., from report ABS-THH-1034. 50p. Dep. CFSTI.

The programs provide shielding calculations for neutrons and gamma radiations for different shield configurations. (M.O.W.)

3539 (ORNL-tr-1913) BACKWARD NEUTRON YIELD FROM A SHIELD UNDER THE INFLUENCE OF PROTONS OF 660 MeV ENERGY. Kimel', L. R.; Komochkov, M. M.; Sidorin, V. P.; Sychev, B. S.; Cherevatenko, A. P. Translated for Oak Ridge National Lab., Tenn., from report JINR-P16-3514. 16p. Dep. CFSTI.

An abstract for the original paper appeared previously in NSA 22: 3149. (M.O.W.)

3540 (ORNL-tr-1947) RADIATION SHIELDING UNDER RESTRICTIVE CONDITIONS. Schlums, K.-D. Translated for Oak Ridge National Lab., Tenn., from Kerntechnik, 9: 205-8 (1967). 9p. Dep. CFSTI.

An abstract of the original article appeared previously in NSA 21: 31475. (M.O.W.)

3541 (ORNL-tr-1948) ON THE CALCULATION OF THE DOSE-RATE OF SCATTERED GAMMA RADIATION. Waechter, K. H. Translated for Oak Ridge National Lab., Tenn., from Kerntechnik, 9: 62-4(1967). 7p. Dep. CFSTI.

An abstract of the original article appeared previously in NSA 21: 23240. (M.O.W.)

3542 (ORNL-tr-2021) TRANSMISSION OF NEUTRONS THROUGH PLANE PARALLEL, MULTILAYER SLABS. Germogenova, T. A.; Suvorov, A. P.; Utkin, V. A. Translated for Oak Ridge National Lab., Tenn., from pp 22-39 of Voprosy Fiziki Zashchity Reaktorov, Sbornik Statei, Vypusk 2, Atomizdat, Moscow, 1966. 34p. Dep. CFSTI.

An abstract of the original paper appeared previously in NSA 21: 21032. (M.O.W.)

3543 DIFFUSION OF FAST NEUTRONS THROUGH CYLINDRICAL DUCTS IN A SHIELD. Artigas, Ricardo. Lafayette, Ind., Purdue Univ., 1968. 225p.

Thesis.

The problem of determining neutron fluxes at the exit of a cylindrical duct in a shield by the use of numerical and stochastic methods was examined. The duct is assumed to have a radius δ and a length l. There is an area source of radius δ and strength N_0, n/sec, at the duct entrance. Up to the present time two methods have been used in solving the problem. The first method approximates the area source by a point source, and an expression for the flux at the center of the duct exit is then found by the use of the albedo concept in one instance and scattering sources in the duct wall, in another instance. The second theoretical approach employs an area source and is based on a solution of the integral transport equation which gives the neutron current, at the exit of the duct. Both of these methods of solution turn out to be quite approximate and are valid only for values of $\lambda(\lambda = \delta^2/l^2)$ much less than 1, i.e., the solutions are valid for very long and narrow ducts. The mathematical approximations used in both of the methods to obtain closed solutions for the equations giving the exit flux or current, are indeed quite restrictive and, therefore, do not yield realistic or reliable results. Both of these methods of solution were examined to determine ranges of validity. Alternative better solutions were developed. In the first method the area source was not approximated by a point source. A numerical solution of the resulting equation was then produced. For various shapes of ducts (values of λ), fluxes at the center of the duct exit were obtained with no restrictions on λ. For the second method of solution an alternative equation was developed, and results were obtained for various specific ducts by the numerical integration of the integral transport equation. Here again, λ has not been restricted. The validity of the numerical methods and the better results obtained (as compared with the previous methods), were proven by the use of a modified version of the Purdue University Lattice Neutron Transport Code (PULANT). The original PULANT code was modified to include cases of cylindrical ducts with area sources. The reliability of the new PULANT program was established by comparing its predictions with experimental data. The Flexible Monte Carlo Code (FMC) was used to determine fluxes at the duct exit due to a point source. Other cases that were investigated were energy spectrum of exit fluxes due to a point source (FMC), number albedoes, and the effects of off-sets (PULANT). It is conclusively demonstrated that the methods of determining values of the neutron streaming fluxes at a duct exit are much more accurate and reliable than use of the older equa-

tions. Also, the modified PULANT program gives an accurate and reliable method of solution. (Disser. Abstr.)

3544 MEASURED FAST-NEUTRON SPECTRA AFTER REFLECTION OF FISSION SOURCE NEUTRONS FROM A NINE-INCH-THICK CONCRETE SLAB. Meyer, Walter; Simons, Gale G.; Kimel, William R. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc., 11: 705-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3545 GAMMA-RAY SPECTRA ARISING FROM THERMAL-NEUTRON CAPTURE IN IRON, ALUMINUM, AND COPPER. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 701-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3546 COMPARISON OF MEASURED AND CALCULATED NEUTRON-CAPTURE GAMMA-RAY SPECTRA. Yost, K. J. (Oak Ridge National Lab., Tenn.); Kremer, S. M. Trans. Amer. Nucl. Soc., 11: 703-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3547 MAD ESTIMATORS FOR GAMMA-RAY SPECTRA. Eckhoff, N. D.; Tillman, F. A.; Simons, G. G.; Kimel, W. R. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc., 11: 471-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3548 LINEAR ENERGY TRANSFORMATION FOR GAMMA-RAY MONTE CARLO CALCULATIONS. Chilton, A. B. (Univ. of Illinois, Urbana). Nucl. Sci. Eng., 34: 328-9(Dec. 1968).

A transformation that provides weighting of photons in proportion to their energy is outlined. (D.C.W.)

3549 ON ONE OF THE PRINCIPLES FOR OPTIMIZATION OF CALCULATIONS BY THE MONTE CARLO METHOD. Mikhailov, G. A. Zh. Vychisl. Mat. i Mat. Fiz., 8: 1085-94(Sept.-Oct. 1968). (In Russian).

The Monte Carlo method, reduced to a consequent modeling of homogeneous Markov chain trajectories, was used to set up an optimization algorithm. (R.V.J.)

Solid-State Physics

Refer also to abstracts 2732, 3299, and 3398.

3550 (AERE-R-5841) FURTHER CALCULATIONS OF NEUTRON SCATTERING CROSS SECTIONS OF POINT DEFECTS IN A RELAXED LATTICE. Martin, D. G. (Atomic Energy Research Establishment, Harwell (England)). July 1968. 16p. Dep. CFSTI. UK 3s. 0d.

Calculations of neutron scattering cross sections for a point defect, allowance being made for the relaxation of lattice atoms due to the defect, involve an infinite summation which cannot be evaluated conveniently. Two approximations have been considered: (a) only atoms which are relaxed by more than a certain value are included in the summation; (b) an improvement to approximation (a) is made by assuming that atoms not included in the summation comprise a continuum. Assuming approximation (b), expressions are derived for (i) the average differential cross section in a polycrystal, (ii) the average total cross section in a polycrystal, and (iii) the total cross section in a single crystal. For a cubic primitive lattice, scattering cross section curves of an interstitial were calculated for (i) and (ii). The expression derived for (iii), however, did not enable specific calculations to be made conveniently on a high-speed computer. As a result, calculations for the total cross section in a single crystal were performed using the simpler approximation (a). It was found that, using approximation (b), cross sections may be calculated quite accurately if only 8 atoms are considered as discrete scatterers, but that accurate calculations of the total cross section in a single crystal using approximation (a) required many more atoms in the summation. Comparison of these results with previous calculations reveals that for a particular approximation and with a specific number of atoms considered as discrete scatterers the resulting accuracy is only slightly sensitive to the type of cross section calculated (i.e., whether it is a differential or total cross section, relating to either a single crystal or a polycrystal). Also when approximation (a) is employed, the accuracy of differential and total cross sections is greatest at large angles and small wavelengths, respectively; the use of approximation (b) results in an additional improvement at smaller angles and longer wavelengths, respectively. (auth) (UK)

3551 (AERE-Trans-1087) ELECTRON MICROSCOPY OF SMALL DEFECT CLUSTERS IN IRRADIATED METALS. II. INVESTIGATIONS ON NEUTRON- AND ION-IRRADIATED COPPER AND NEUTRON-IRRADIATED NICKEL. Ruehle, M. Translated by O. S. Whitston for Atomic Energy Research Establishment, Harwell, Eng., from Phys. Status Solidi, 19: 279-95(1967). 22p. Dep. CFSTI. UK 3s.

An abstract of the original article appeared previously in NSA 21: 11715. (M.O.W.)

3552 (CEA-R-3486) CONTRIBUTION TO THE STUDY OF SOLID ^{3}He BY NUCLEAR MAGNETIC RESONANCE. Landesman, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1968. 130p. (In French). Dep.

Thesis. Submitted to Univ., Paris.

Due to the unusually large zero point motion of ^{3}He atoms in the solid, the overlap of the atomic wave functions is very important. As a consequence, there are exchange interactions, the theoretical calculation and the experimental measurement of which are discussed. Nuclear magnetic resonance is especially well suited for the latter. A detailed theory is given for both exchange narrowing and Zeeman-exchange cross relaxation, which phenomena are used to measure the exchange interaction as a function of molar volume. The alignment temperature is thus known; it goes down when the pressure goes up and is never higher than three millidegrees. An influence of ^{4}He impurities on the exchange interactions between ^{3}He atoms which are neighbors of the substitutional ^{4}He is shown. (auth)

3553 (CISE-116) INDEXING OF ELECTRON DIFFRACTION SPOTS OBTAINED FROM ZIRCONIUM LATTICE. Gardini, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). June 1968. 53p. Dep.

The theoretical notions necessary to carry out the analysis of electron-diffraction patterns, with particular reference to hexagonal lattices, are briefly reported. The difficulties encountered in analyzing zirconium lattice and the method followed to overcome them are dealt with. Finally, the results of a series of measurements for the determination of the diffraction constant and a repertory of 48 schemes useful in indexing zirconium lattice diffraction spots are reported. (auth)

3554 (IN-1226) DIPOLE SUM: A COMPUTER PROGRAM FOR CALCULATING DIPOLE SUMS FOR AN ARBITRARY CRYSTAL. Boyter, J. K.; Worlton, T. G. (Idaho Nuclear Corp., Idaho Falls). Oct. 1968. Contract AT(10-1)-1230. 36p. Dep. CFSTI.

A Fortran IV (IBM 7044) program (PPC040*0968) for calculating the dipole sums for an arbitrary crystal is described. Examples are given in the appendixes for BeO (wurtzite structure), Mg_2Sn (fluorite structure), and sodium chloride. (auth)

3555 (JPRS-45638) THE EFFECT OF RADIATION ON THE ELECTROPHYSICAL PROPERTIES OF BARIUM TITANATE AND MATERIALS BASED ON IT. Solov'ev, S. P.; Kuz'min, I. I.; Kharchenko, V. A. Translated from Izv. Akad. Nauk SSSR, Ser. Fiz., 31: 1757-61(1967). 8p. CFSTI.

An abstract of the original paper appeared previously in NSA 22: 18845. (M.O.W.)

3556 (PAEC(A)IN-674) NUCLEAR MAGNETIC RESONANCE. A Literature Search. (Philippine Atomic Energy Commission, Manila). May 1968. 92p. Dep.

Five hundred and fifty-nine references are presented on nuclear magnetic resonance under the following headings: biology and medicine; chemistry; engineering; geology; meteorology and mineralogy; instrumentation; isotope technology; metals, ceramics and other materials; physics, reactor technology; and general and miscellaneous. (B.G.D.)

3557 (SC-RR-68-538) THE DETERMINATION OF THE ELEVATED TEMPERATURE SEEBECK COEFFICIENTS OF COMMON THERMOCOUPLE MATERIALS REFERENCED TO PLATINUM. White, R. M. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1968. 32p. Dep. CFSTI.

The elevated temperature Seebeck coefficients of common thermocouple materials referenced to platinum are determined and presented in tabular form for both the Centigrade and Fahrenheit temperature scales. The data are also presented as a polynomial series, with appropriate polynomial coefficients determined. (auth)

3558 (UCRL-18461) NUCLEAR RELAXATION OF ^{63}Cu IN Ni-Cu. Bancroft, Michael H. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1968. Contract W-7405-eng-48. 72p. Dep. CFSTI.

Thesis.

Nuclear magnetic relaxation of ^{63}Cu in dilute Ni-base–Cu alloys was measured in the temperature range 2.1 to 300°K. The observed spin echo comes from nuclei in the wings of the domain walls in zero applied field and from nuclei in the saturated bulk in large external field. The longitudinal relaxation rate was found to be proportional to the temperature in both cases. $T_1T = 0.1$ sec °K and 1.02 ± 0.10 sec °K was found for zero and high external fields, respectively. The difference between these rates is attributed to a mechanism involving the domain walls. Comparison of the high field rate is made with Moriya's calculation for pure transition metal ferromagnets. It is concluded that there is little or no contribution from the d band to the relaxation of an isolated Cu atom in Ni. This strongly suggests that a Cu atom in Ni has no local moment. In the helium temperature range, the transverse relaxation is dominated by spin–spin interactions for Cu concentrations as low as 1%. (auth)

3559 (WAPD-Trans–0093) INVESTIGATION OF THE ACTIVE CRYSTAL LENGTH IN THE PLASTIC RANGE OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. 1. THE FORMATION OF SLIP BANDS. Neuhauser, H. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Phys. Status Solidi, 25: 593-608(1968). 32p. Dep. CFSTI.

Thesis. Submitted to Univ. of Munich, Ger.

An abstract of the original article appeared previously in NSA 22: 17778. (M.O.W.)

3560 KNIGHT SHIFTS OF ^{31}P IN THE PARAMAGNETIC STATE OF THE UP–US SOLID SOLUTIONS. Kuznietz, M.; Matzkanin, G. A.; Baskin, Y. (Argonne National Lab., Ill.). Phys. Lett., 28A: 122-3(Nov. 4, 1968).

Knight shifts of ^{31}P were measured in the paramagnetic state of UP–US solid solutions. For all compositions, $K = K_0 + \alpha\chi_M$. $|K_0| \ll K$, and $\alpha = 4.0 \pm 0.5$ (cgs). In the uniform conduction-electron polarization model, $J_{sf} = -(2.4 \pm 0.4)$ eV is obtained. (auth)

3561 ELECTRON PARAMAGNETIC RESONANCE IN IRRADIATED ZIRCON CRYSTALS WITH IMPURITIES. Samoilovich, M. I.; Novozhilov, A. I.; Barsanov, G. P. (All-Union Scientific-Research Inst. of Mineral Resources, Aleksandrov, USSR). Geokhimiya, No. 4, 494-5(Apr. 1968). (In Russian).

The EPR method was used for determining radiation effects on natural $ZrSiO_4$ crystals irradiated by ^{60}Co γ rays and x rays at room and liquid nitrogen temperatures. Results showed that irradiated zircon exhibited a series of paramagnetic centers, the origin of which remained unknown and demands further studies. (R.V.J.)

3562 OXYGEN SURFACE-DENSITY MEASUREMENTS BASED ON CHARACTERISTIC X-RAY PRODUCTION BY 100-keV PROTONS. Hart, R. R. (Univ. of California, Berkeley); Olson, N. Thomas; Smith, Harold P. Jr.; Khan, J. M. J. Appl. Phys., 39: 5538-41(Nov. 1968).

The oxygen K x-ray yield from known thicknesses of aluminum oxide ($1-70$ μg O/cm^2), bombarded by 100-keV protons, indicates that oxygen surface density may be measured over the range from 50 to 0.004 μg/cm^2. At the lower limit, background is 50% of the signal. In thin oxide layers where proton energy loss and x-ray absorption are negligible, the x-ray yield I (x rays/proton) is related to the oxygen surface density t (μg/cm^2) by $I = (2.9 \times 10^{-6})t$. (auth)

3563 EFFECT OF 50-MeV ELECTRONS OF THE ULTIMATE FERMI LEVEL IN GERMANIUM. Bohlke, W. H.; Kalma, A. H.; Corelli, J. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Appl. Phys., 39: 5498-5502(Nov. 1968).

p-type Ge doped with Ga and In to resistivities ranging from 0.001 to 30 Ω · cm and n-type Ge doped with Sb and As to resistivities ranging from 0.1 to 30 Ω · cm were irradiated with 50-MeV electrons to various doses up to a maximum total integrated flux of 1.0×10^{19} electrons/cm^2. Electrical measurements were performed to determine the effect of irradiation on the temperature dependence (78 to 320°K) of the conductivity, carrier concentration, and Fermi level. After irradiation to relatively high doses ($\gtrsim 10^{18}$ electrons/cm^2), both types of Ge reach a saturation in the hole concentration which is accompanied by an ultimate value for the Fermi level at $E_v + 0.220 \pm 0.010$ eV for all samples studied. Comparison of this result with studies made using fast neutrons shows that the position of the ultimate Fermi level strongly depends on the damaging or "disordering" capabilities of the incident radiation. It is found that the ultimate Fermi level is positioned closer to the valence band as a result of irradiation by particles capable of imparting a larger maximum recoil energy to the Ge atom. Finally, a comparison is made with the work of others on the ultimate position of the Fermi level for Ge irradiated by ^{60}Co gamma rays and 4.5-MeV electrons which are not sufficiently energetic to produce disordered regions comparable to what is observed in fast-neutron and 50-MeV electron irradiation of Ge. (auth)

3564 RADIATION COMPACTION OF VITREOUS SILICA. Primak, William; Kampwirth, Robert (Argonne National Lab., Ill.). J. Appl. Phys., 39: 5651-8(Nov. 1968).

The dilatations (negative) caused by neutrons, 40- to 600-keV electrons, 140-keV H^+, D^+, He^+, and gamma rays are given as a function of dose and are compared. The presaturation dependence is linear for neutrons, He^+, and D^+, and depends on the 0.5 to 0.7 power of dose for H^+, electrons, and gamma rays. The dilatations are not temperature dependent from about 0 to 100°C, hence are not thermally activated. The dilatations are explained as compaction of the silica structure resulting from oxygens moving into some of the "free volume," the structural change being similar to that occurring on pressure, shock, or thermal compaction of vitreous silica. The mechanism given for the neutron-induced compaction involves the state of high vibrational excitation developed in the slowing down of scattered atoms. The compaction by gamma rays, electrons, protons, or deuterons is explained as caused by transient ionization relaxing Si–O binding to permit oxygens to move into the "free volume" where they may be locked-in on recombination by similar incidents occurring nearby. The reduced power dependence is explained as a "hardening" effect; succeeding events are more difficult to perform or are performed with lower probability. The compaction caused by He^+ (140-keV) seems to possess an equal contribution from ionization compaction and that caused by energy transfer to atomic vibrations. (auth)

3565 ORIENTATION DEPENDENCE OF PITTING AND BLISTERING IN PROTON-IRRADIATED ALUMINUM CRYSTALS. Milacek, Leonard H.; Daniels, Raymond D. (Univ. of Oklahoma, Norman). J. Appl. Phys., 39: 5714-17(Nov. 1968).

Pitting and blistering occurred on the surfaces of aluminum crystals bombarded with protons in the 10- to 100-keV energy range. The extent of pitting and/or blistering was found to be orientation dependent. Surfaces with orientations near {111} were least affected. This was followed by the {100} orientation. {110} and higher indices orientations suffered greatest damage. Blistering is caused by the protons trapped as hydrogen gas, and the orientation dependence of the process is explained by the orientation dependence of penetration of ions in the aluminum lattice. (auth)

3566 EJECTION PATTERNS IN LOW-ENERGY SPUTTERING OF GaAs AND GaP CRYSTALS. Comas, James (Naval Research Lab., Washington, D. C.); Cooper, C. Burleigh. J. Appl. Phys., 39: 5736-9(Nov. 1968).

The angular distribution of particles sputtered from single crystals of GaAs and GaP has been studied. The (110), (111), and $(\bar{1}\bar{1}\bar{1})$ faces of the crystals were bombarded normally with Ar ions with energies ranging from 100 to 600 eV. Crystal temperatures were varied between 50 and 525°C. From the (110) face a strong normal ⟨110⟩ spot appeared. From the (111) face, three strong ⟨110⟩ spots appeared, accompanied by less-intense and less-well-defined ⟨114⟩ spots. From the $(\bar{1}\bar{1}\bar{1})$ face no preferential ejection was noted. The clarity of the spots improved with increasing target temperature. (auth)

3567 FIELD-ION MICROSCOPE OBSERVATION OF DISLOCATIONS IN TUNGSTEN. Zeedijk, H. B. (Metaalinstituut TNO, Delft, Netherlands). J. Appl. Phys., 39: 5800-2(Nov. 1968).

The occurrence of "horseshoes" (horseshoe shape in the edge of central net plane) in tungsten is reported. The specimen had the [110] orientation and the tip radius was ~215 Å, and the resulting field-ion micrographs from the field evaporation series are given and discussed. Initially, the edges of two net planes of the central (110) plane have the horseshoe shape; during field evaporation, the two horseshoes disappear successively. Each horseshoe may correspond with one pair of dislocations, each of which has a Burger's vector component in the [110] specimen axis and is of opposite sign. Possible processes for the disappearance of the horseshoes are described. (D.L.C.)

3568 CRYSTAL STRUCTURES AND MAGNETIC PROPERTIES OF THE INTERMETALLIC COMPOUND Fe_2Zr. Kai, Kenzo; Nakamichi, Takuro; Yamamoto, Mikio (Tohoku Univ., Sendai). J. Phys. Soc. Jap., 25: 1192(Oct. 1968).

The crystal structure and magnetic properties of the Fe_2Zr phase alloys were investigated in detail over a wide composition range around the stoichiometric composition. It was established from the result of the x-ray and magnetic measurements that two single-phase regions of hexagonal ($MgNi_2$-type) and of cubic ($MgCu_2$-type) Laves phases are located in two separate composi-

tion ranges from 27.3 to 31.4 at.% Zr and from 32.8 to 34.0 at.% Zr, respectively. Results of magnetic analysis show that the data obtained by others lie between those of the present work. Moreover, the results suggest that an excess Fe atom at the A site not only has a magnetic moment but also produces larger magnetic moments of Fe atoms at B sites surrounding it. (M.H.R.)

3569 THEORY OF SPIN WAVES IN FERROMAGNETIC METALS WITH MULTIPLE BANDS. II. INELASTIC SCATTERING OF NEUTRONS BY SPIN WAVES. Yamada, Hideji; Shimizu, Masao (Nagoya Univ., Japan). J. Phys. Soc. Jap., 25: 1001-7 (Oct. 1968).

Inelastic scattering of neutrons by spin is investigated in ferromagnetic metals with multiple bands. Differential scattering cross sections due to various branches of spin waves are estimated. It is found that at 0°K the differential scattering cross section due to spin waves in an acoustical intraband branch shows a maximum as a function of the momentum of spin waves, because of the existence of an acoustical interband branch. In the two band model, the dispersion relations of spin waves and the differential scattering cross sections are numerically calculated. A possibility of the observation of the neutron scatterings due to the acoustical interband branch is discussed. (auth)

3570 LUMINESCENCE IN CsI:Tl. Towyama, Takashi (Kobe Industries Corp., Hyogo, Japan); Morita, Itsuo; Ishiguro, Masakazu. J. Phys. Soc. Jap., 25: 1133-8(Oct. 1968).

The luminescence in pure CsI and CsI(Tl) crystals containing various concentrations of Tl have been measured upon excitation by beta rays over the temperature range from −180°C to +20°C. The emission spectra in pure CsI at low temperatures have two peaks whose temperature dependence are different from each other. In the case of CsI(Tl), the temperature dependence of the luminescence near 400 mμ is quite different from that of longer-wavelength luminescence. In the longer-wavelength region around 500 mμ, several glow peaks are observed from the samples of higher concentration of Tl. The process of luminescence in CsI(Tl) are roughly explained by using the self-trapped hole model. (auth)

3571 CHANGES IN M-BAND OF LiF CRYSTALS DURING IRRADIATION AT ROOM TEMPERATURE. Nakajima, Toshiyuki (National Inst. of Radiological Sciences, Chiba, Japan). Jap. J. Appl. Phys., 7: 1418-19(Nov. 1968).

Pure LiF crystals were exposed in the dark to cobalt-60 gamma rays to form color centers. The optical absorption spectra show that the half-width of the M-band is constant at 10^6 to 10^7 R, but it is increased for exposures of 8×10^7 R and above. The prolonged irradiation produces weak bands centered at 528 and 550 mμ, and it is concluded that the half-width increase and broadening of the M-band are due to the composite band with M-, R^+-, and 437-mμ bands. The growth of the N_2 band induced by M light at liquid nitrogen temperature is described. (D.L.C.)

3572 INVESTIGATION OF CONDENSED MATTER BY MEANS OF NEUTRON SCATTERING. Haelg, W. (Eidgenoessisches Technische Hochschule, Zurich). Helv. Phys. Acta, 41: 868-71 (Oct. 20, 1968). (In German).

The magnetic phase transition in EuSe was investigated by means of neutron scattering. As the ferromagnetic intensity contribution to the nuclear (111) reflex shows, without external magnetic field there is a considerable spontaneous magnetization at 1.9°K. The relation between the structure factor, phonon dispersion, and electrical resistance of liquid Zn was also discussed on the basis of neutron scattering measurements. (J.S.R.)

3573 EVIDENCE OF ENERGY TRANSFER FROM PAIR GADOLINIUM IONS TO OTHER RARE EARTHS IN YTTRIUM–GADOLINIUM OXIDE CRYSTAL. Ozawa, Lyuji; Nishikawa, Satoru (Dai Nippon Toryo Co., Ltd., Kanagawa, Japan). Jap. J. Appl. Phys., 7: 1354-60(Nov. 1968).

Energy transfer from gadolinium ions to other emissive rare earths in $(Y,Gd)_2O_3$ crystals is investigated using excitation spectra of the rare earth emissions. Noticeable energy transfer from gadolinium ions to Sm^{+3}, Eu^{+3}, and Dy^{+3} ions is observed when Gd^{+3} concentrations in the solid solution crystals are over 0.01 mole. The energy transfer to Tb^{+3} and Er^{+3} is also observed, but smaller. The evidence of energy transfer is not detected as for Pr^{+3}, Ho^{+3} or Tm^{+3}. Emission intensities of the rare earths as energy acceptors under direct excitation of the gadolinium ions increase with 2nd power of gadolinium concentrations between 0.01 and 0.1 mole. This indicates that the energy transfer arises from paired gadolinium ions. The optimum gadolinium concentration for the energy transfer is about 0.15 mole and this concentration slightly shifts to higher concentration side as concentrations of the energy acceptor ions increase. The transmission of energy involves a radiationless process. (auth)

3574 SPIN-CORRELATION IN EuS. Quattropani, A.; Enz, C. P. (Univ., Geneva). Helv. Phys. Acta, 41: 1109-12(Oct. 20, 1968). (In German).

The spin correlation of EuS was calculated with consideration of the Busch–Wachter effect and the results were compared with the results of calculations by the constant-coupling approximation. The magnetic specific heat of EuS was also determined as a function of temperature and compared with experimental results. The importance of the Busch–Wachter effect for the problem of spin correlation in the Heisenberg ferromagnets was demonstrated. (J.S.R.)

3575 CRYSTAL FIELD IN RARE-EARTH TRICHLORIDES. III. CHARGE PENETRATION AND COVALENCY CONTRIBUTIONS IN $PrCl_3$. Ellis, M. M. (Oxford Univ.); Newman, D. J. J. Chem. Phys., 49: 4037-43(Nov. 1, 1968).

A previous calculation has been corrected by taking into account the electrostatic-charge-penetration contribution and extended by including the covalency contribution. These are particularly relevant in the calculation of the n = 6 parameters, which are now brought into reasonable agreement with experiment. (auth)

3576 STUDY BY MOESSBAUER EFFECT AND BY NEUTRON DIFFRACTION OF THE COMPOUND $UFeO_4$. Bacmann, Madeleine; Chevalier, Raymond; Bertaut, Erwin Felix; Roult, Georges; Belakhovsky, Michel (Centre d'Etudes Nucleaires, Grenoble, France. CNRS, Grenoble, France). Compt. Rend., Ser. A and B, 267: 518-21(Sept. 2, 1968). (In French).

The Moessbauer effect and neutron diffraction show that at $T_N = 55°K$ the moments of the Fe in $UFeO_4$ are ordered antiferromagnetically along Oy. At $T_c = 42°K$ a new order appears with a strong ferromagnetic component. It is identical to that observed at 4.2°K and previously described. (tr-auth)

3577 MAGNETIC INTERACTIONS BETWEEN RARE-EARTH IONS IN INSULATORS. III. EPR MEASUREMENTS OF Ce^{3+} PAIR-INTERACTION CONSTANTS IN $LaCl_3$. Birgeneau, R. J. (Yale Univ., New Haven. Oxford Univ.); Hutchings, M. T.; Rogers, R. N. Phys. Rev., 175: 1116-33(Nov. 15, 1968).

In order to investigate the form of interaction between non-S-state, Kramers rare-earth ions, the electron paramagnetic resonance spectra from pairs of Ce^{3+} ions in $LaCl_3$ have been measured at 4.2°K and at 25 and 36 GHz. The spectra have been fitted to a general effective-spin pair-Hamiltonian in order to obtain values for the g tensors and certain terms in the interaction tensors K. By using additional data from bulk-property measurements on $CeCl_3$, values for all the terms in K can be deduced. The contributions to the measured parameters from the various interaction mechanisms thought to be present in rare-earth compounds are discussed in detail. Apart from the usual magnetic dipole interaction, it is generally difficult to identify each contribution unambiguously. In the present case, however, because of the simple nature of the Ce^{3+} wave functions, there is clear evidence for the existence of an electric quadrupole–quadrupole interaction between next-nearest-neighbor ions, and its magnitude has been determined. There is also unambiguous evidence for anisotropic superexchange of the type suggested by Levy and by Elliott and Thorpe, and it is found that this has matrix elements of magnitude comparable with the more usual bilinear exchange interaction, which is also present. (auth)

3578 THE EFFECT OF γ IRRADIATION UPON THE DENSITY OF ALKALI METAL HALIDE CRYSTALS. Andreev, G. A.; Vasil'ev, G. Ya. (Ioffe of Physics and Tech. Inst., Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 10: 1030-4(Nov. 1968). Translated from Fiz. Tverd. Tela, 10: 1292-7(May 1968).

The density changes due to gamma irradiation (at room temperature) of LiF, NaF, NaCl, and KCl single crystals were measured by a flotation method. The total irradiation dose amounted to 1×10^8 to 3×10^8 R. The dose rate was 200 R/sec. The relative change in the crystal density decreases from LiF to NaF and from NaCl to KCl at equal exposure doses. The effect of impurities in LiF and NaCl upon $\Delta\rho/\rho$ was investigated. O^{2-} + OH^- and Mg^{2+} admixtures in LiF increase somewhat the rate at which defects accumulate during the irradiation. In the case of NaCl, Li^+ and K^+ admixtures do not affect the density changes from irradiation, whereas Ca^{2+}, Sr^{2+}, and Ba^{2+} admixtures enhance the density changes considerably. Vacancies accumulate in (pure) NaCl crystals obtained from a melt or from an aqueous solution at the same rate. In KCl the increase of the vacancy concentration during an irradiation depends upon a previous annealing of the crystals. It is proposed that the effect of admixtures on the rate of defect buildup is expressed by a change in the recombination rate of the defects during the irradiation. (auth)

3579 THERMAL AND ELECTRICAL PROPERTIES OF LANTHANUM ANTIMONIDE. Goncharova, E. V.; Zhuze, V. P.; Zhdanova, V. V.; Zhukova, T. B.; Smirnov, I. A.; Shadrichev, E. V. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 10: 1052-7(Nov. 1968).

Translated from Fiz. Tverd. Tela, 10: 1322-9(May 1968).

The Hall coefficient, the thermal conductivity, the linear expansion coefficient, the lattice constant, the electrical resistivity, and the thermoelectric power of LaSb were investigated in a wide range of temperatures. A phase transition associated with a rearrangement of the crystal lattice was found in the temperature range 630 to 720°K. Analysis of the experimental data obtained at temperatures below the phase transition point indicates that LaSb is a semimetal with overlapping bands. (auth)

3580 NEUTRON SCATTERING STUDY OF STRUCTURE AND PHASE TRANSITIONS IN NIOBIUM HYDRIDES AND DEUTERIDES. Somenkov, V. A.; Gurskaya, A. V.; Zemlyanov, M. G.; Kost, M. E.; Chernoplekov, N. A.; Chertkov, A. A. Sov. Phys.-Solid State (Engl. Transl.), 10: 1076-82(Nov. 1968).

Translated from Fiz. Tverd. Tela, 10: 1355-63(May 1968).

Niobium hydrides and deuterides at compositions close to equiatomic were studied by neutron and thermal methods. The existence of phase transitions associated with the ordering of the light atoms was established, the structures of the low- and high-temperature phases were determined, and isotopic and concentration shifts in the temperature of the order–disorder transition were discovered. (auth)

3581 INVESTIGATION OF SURFACE SELF-DIFFUSION OF NIOBIUM IN A STRONG ELECTRIC FIELD BY MEANS OF FIELD-EMISSION MICROSCOPE. Odishariya, G. A. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 10: 1130-5(Nov. 1968).

Translated from Fiz. Tverd. Tela, 10: 1425-32(May 1968).

A Müller field-emission microscope was used to investigate the change of a heated Nb emitter tip in the presence of a strong electric field (rebuilding). The sequence of changes in emission patterns during the rebuilding process is described. The method proposed by I. L. Sokol'skaya was used to determine the activation energy of Nb surface diffusion in the presence of a field: Q_F = 2.14 ± 0.06 eV. The magnitude of Q_F was investigated as a function of the field F. The contribution of the field to the activation energy increases from 0.23 ± 0.03 to 0.49 ± 0.05 eV with heating time; this is explained by the change of the curvature of the emitting surface in the course of rebuilding. It is shown that the mean radius of the emitter decreases at the same time from 4900 to 3300 Å. As the rebuilding process proceeds, only a single excrescence on (111) is strongly developed having a still smaller radius (500 to 1500 Å). At the early stage of the rebuilding process, when the changes in tip shape are still insignificant, Q_F = 0.23 eV; the activation energy for surface diffusion in the absence of a field is then $Q_{F=0}$ = (2.14 ± 0.06) + (0.23 + 0.03) = 2.37 ± 0.09 eV. An attempt was made to estimate the surface tension coefficient of Nb: γ = 2400 dyn/cm at T = 1400°K. (auth)

3582 THE INFLUENCE OF FERROMAGNETIC IMPURITIES ON THE SUSCEPTIBILITY OF GADOLINIUM NEAR THE CURIE POINT. Boyarskii, L. A.; Starikov, M. A. Sov. Phys.-Solid State (Engl. Transl.), 10: 1143-7(Nov. 1968).

Translated from Fiz. Tverd. Tela, 10: 1442-7(May 1968).

The dependence of the magnetic susceptibility of a number of polycrystalline and single-crystal samples of gadolinium on the temperature in the range near the Curie point has been investigated by a vibrational magnetometer method. The measurements were carried out in a field of 24 Oe. The samples contained different amounts of iron and cobalt impurities. The experimental results in the paramagnetic region can be described by an equation of the form $1/\chi = (1/\chi_0) + p(T - T_C)^{\gamma}$ ($0.2° < T - T_C < 16°$), where T_C is the Curie temperature. The constants $1/\chi_0$ and p have similar values for the different samples, whereas the exponent γ depends significantly on the concentration of ferromagnetic impurities. Values of γ equal to 1.32, 1.17, and 1.14 were obtained for samples containing 1×10^{-3}, 1×10^{-2}, and 1×10^{-1}% Fe, respectively. For the sample containing 1×10^{-2}% Fe and 1×10^{-2}% Co, γ = 1.13. The accuracy of determination of γ was 0.02. (auth)

3583 INTERACTION OF DISLOCATIONS WITH RADIATION DEFECTS IN GERMANIUM. Khainovskaya, V. V.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Solid State (Engl. Transl.), 10: 1224-5(Nov. 1968).

Translated from Fiz. Tverd. Tela, 10: 1549-50(May 1968).

Samples of n- and p-type Ge in which a dislocation density of 10^4 cm^{-2} was induced by plastic bending were quenched after exposure to various temperatures in the range 100 to 450°C, irradiated by 3.5-MeV electrons, and examined for displacement of dislocations. The dependence of the dislocation displacement on the quenching temperature for a constant dose had a maximum at about 150°C. At room temperature a larger radiation dose was required to reach saturation of the dislocation displacements than at higher temperatures. It is concluded that the most likely obstacles to effective interaction of dislocations with interstitial atoms are impurity atmospheres at dislocations. (A.G.W.)

3584 SINGULARITIES IN THE ENERGY DISTRIBUTION OF SLOW NEUTRONS INELASTICALLY SCATTERED IN CRYSTALS HAVING EXTENDED DEFECTS. Iosilevskii, Ya. A. (Inst. of Solid State Physics, Chernogolovka, USSR). Sov. Phys.-Solid State (Engl. Transl.), 10: 1243-5(Nov. 1968).

Translated from Fiz. Tverd. Tela, 10: 1567-70(May 1968).

The possibilities of experimental detection of singularities in the spectral functions of crystals having line or plane defects by single-phonon nuclear scattering of slow neutrons are discussed theoretically. Possible types of phonon-spectrum singularities in crystals with linear and two-dimensional defects are shown. (A.G.W.)

3585 DIFFUSION-DISLOCATION CRYSTAL FLOW UNDER THE IRRADIATION EFFECT WITH ALLOWANCE FOR FORMATION OF GAS ATOMS. Slezov, V. V. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 13: 1505-14(Sept. 1968). (In Russian).

The complete system of equations describing the creep of the crystal under irradiation is obtained, the formation of gas atoms being taken into account. The velocity of the plastic flow and intumescence of the sample are computed. (auth)

3586 ELEKTRONNYE I IONNYE PROTSESSY V TVERDYKH TELAKH. III. (Electron and Ion Processes in Solids. III). Tbilisi, USSR, Izdatel'stvo Metsniereba, 1968. 140p.

Twelve articles are included on radiation physics of ionic crystals, resonance and relaxation in magnetic fields, and magnetic neutron scattering. Results of experimental studies of neutron irradiation effects on mechanical and physical properties of alkali halides (lithium fluoride, potassium chlorides) are analyzed. Theoretical studies of cyclotron resonance and nuclear relaxation in a quantized field are discussed. Kinetics of local defects in alkali metal halide crystals irradiated in a reactor and critical magnetic neutron scattering on holmium are evaluated. (R.V.J.)

3587 LOCALIZED EXCITATIONS IN SOLIDS. Proceedings of the First International Conference held at the University of California at Irvine, September 18–22, 1967. Wallis, R. F. (ed.). New York, Plenum Press, 1968. 797p. (CONF-670968).

Localized excitation of phonons, magnons, plasmons, and excitons is discussed. The unifying feature is that the theory is substantially the same for each. Some topics covered are the characteristics, interactions, and effects on observable physical properties of localized excitations. (M.H.R.)

3588 EFFECT OF FORCE-CONSTANT CHANGES ON THE INCOHERENT NEUTRON SCATTERING FROM CUBIC CRYSTALS WITH POINT DEFECTS. Lakatos, Katja; Krumhansl, J. A. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-3699. Phys. Rev., 175: 841-58(Nov. 15, 1968). (NYO-3699-32).

This is a study of the vibrational properties of random substitutional impurities and their nearest neighbors in cubic monatomic harmonic crystals in the low-impurity-concentration limit. Mass changes, as well as force-constant changes between the impurity and its nearest and, in some cases, next-nearest neighbors, are taken into account. The problem is formulated in terms of an incoherent-neutron-scattering experiment, although the results are useful for other experiments as well. Analytic expressions are given for the resonance frequencies for all the normal modes of the defect cage in fcc and bcc lattices. Expressions for the mean-square displacement of the impurity and its nearest neighbors at all frequencies are given for the fcc case. Results are expressed in terms of perfect-lattice Green's functions. Numerical computations are performed on Al containing heavy impurities. The Al-impurity force constants are treated as parameters which are varied over a wide range. (auth)

3589 PARAMAGNETIC NH_3Cl AND NH_3Br COLOR CENTERS IN IRRADIATED AMMONIUM HALIDE SINGLE CRYSTALS. Patten, Frank W. (Naval Research Lab., Washington, D. C.). Phys. Rev., 175: 1216-27(Nov. 15, 1968).

Radiation-induced NH_3Cl and NH_3Br defect centers have been studied in ammonium halide single crystals by EPR and optical spectroscopy. The defects are most likely formed by removal of H^0 from an ammonium ion with subsequent bonding of NH_3^+ to X^- along a ⟨111⟩ direction. In the NH_3Cl center, NH_3^+ is a nearly planar group loosely bonded to a Cl^-; in the NH_3Br center there

is more tendency toward sp^3 hybridization of the N orbitals, and stronger covalency within the nitrogen–halogen bond. The molecular orbital description of these centers shows a strong similarity to that of mixed V_K color centers in the alkali halides. Optical absorptions due to the NH_3Cl and NH_3Br centers were observed at 3.31 and 3.14 eV, respectively. The NH_3Cl defects were observed to undergo thermally induced reorientations which are strongly influenced by the ordering of the surrounding ammonium ions at low temperature. (auth)

3590 EFFECT OF ION BOMBARDMENT ON THE ELECTRICAL CONDUCTIVITY OF GERMANIUM. Primak, William (Argonne National Lab., Ill.); Dayal, Yogeshwar. Phys. Rev., 175: 1033-8(Nov. 15, 1968).

Nearly intrinsic germanium specimens were bombarded with H, D, He, Ne, and Ar ions of several energies between 20 and 140 keV at room temperature, and measurements were made at room temperature. Evidence was found for two kinds of annealing. The change of electrical conductivity as a function of depth from the bombarded surface was determined by stripping the surface with 3% H_2O_2 etching solution. The depth of the damage was surprisingly great and is explained as a peculiar radiation-assisted diffusion of interstitial atoms. On extended bombardment with Ne or Ar ions, a dip in conductivity appeared at a depth about that of the expected most probable range. For some specimens it was great enough to cause a maximum in the damage–dose curves. (auth)

3591 RECOMBINATION LUMINESCENCE IN IRRADIATED SILICON. Spry, Robert J.; Compton, W. Dale (Univ. of Illinois, Urbana). Phys. Rev., 175: 1010-20(Nov. 15, 1968).

Radiative recombination of optically injected carriers has been observed in ^{60}Co-γ-ray- and neutron-irradiated silicon. All samples were irradiated at room temperature and stored at room temperature following irradiation. The luminescent spectrum is complex and exhibits sharp structure at liquid-helium temperature. In both n- and p-type float-zone-grown material, the spectrum is dominated by a very intense sharp band located at 0.971 eV. In both n- and p-type pulled crystals the same spectrum appears, but an additional spectrum is found that is shifted to lower energies by 0.180 eV, with a very intense sharp band located at 0.791 eV. The major features of both spectra are independent of the type and amount of doping impurities of valence III or V, and the type and amount of irradiation. The defect associated with the lower-energy spectrum anneals at room temperature, while the defect associated with the higher-energy spectrum is stable at room temperature. An additional band associated with a third defect is found at 0.794 eV in γ-irradiated pulled crystals under certain conditions. Measurements of the luminescence at liquid-nitrogen temperature are consistent with those at liquid-helium temperature. It is suggested that the luminescence of the two major portions of the spectra are due to both phononless and phonon-assisted recombination of free holes and trapped electrons in the ground states of two different defects. Subtraction of the energies of the sharp bands found in the luminescence spectra from the band-gap energy yields 0.194 and 0.374 eV as the energies of the traps below the conduction-band minima. (auth)

3592 STORED-ENERGY RELEASE IN ELECTRON-IRRADIATED GERMANIUM. Singh, M. G.; MacKay, J. W. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-125. Phys. Rev., 175: 985-90(Nov. 15, 1968).

Stored-energy release measurements have been made on heavily doped n- and p-type specimens of germanium following irradiation at 15°K by 1.0-MeV electrons. A novel feature of the technique is the use of a portion of the specimen as one element of a germanium/copper thermocouple to detect small temperature differences arising from stored-energy release. The experimental results indicate that there are several annealing stages in the temperature range from 20 to 80°K in which stored energy is released in n-type germanium. This is interpreted to mean that the annealing involves recombination of vacancies and interstitials. No measurable release of energy is observed in p-type germanium over the above temperature range. Comparing the energy release to previous measurements of electrical properties indicates that the return of one electron to the conduction band in n-type germanium is accompanied by the release of 5.5 ± 1.5 eV in thermal energy for annealing stages between 30 and 60°K, and 3.7 ± 1.8 eV for stages between 60 and 80°K. (auth)

3593 ISOTOPE EFFECT FOR DIFFUSION OF IRON IN VANADIUM. Coleman, M. G. (Univ. of Illinois, Urbana); Wert, C. A.; Peart, R. F. Phys. Rev., 175: 788-95(Nov. 15, 1968).

The diffusion coefficients of iron, using ^{59}Fe as the radioactive tracer, and the isotope-effect parameter, using ^{55}Fe and ^{59}Fe as tracers, have been measured in vanadium over a temperature range of more than 800°C by standard sectioning and counting techniques. The diffusion of ^{59}Fe in vanadium exhibits the anomalous behavior of having not one but two straight lines in a plot of lnD versus 1/T, with a change of slope occurring near 1350°C. The data have been analyzed into the sum of two exponentials: $D = 2280 \exp(-101{,}500/RT)$ at high temperatures, and $D = 0.0936 \exp(-67{,}600/RT)$ at low temperatures. The values of the isotope-effect parameter for the ^{59}Fe and ^{55}Fe isotopes are approximately constant near 0.7 at low temperatures, but decrease rapidly with increasing temperature above 1350°C. The measurements are interpreted to indicate that two mechanisms of diffusion operate in vanadium. The mechanism predominant at low temperatures is identified as motion of a single vacancy; that at high temperatures is probably motion of divacancies. (auth)

3594 PROTON CHANNELING THROUGH THIN CRYSTALS. Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.); Mitchell, I. V.; Nelson, R. S.; Farmery, B. W.; Thompson, M. W. Phil. Mag., 18: 985-1016(Nov. 1968).

The channeling of energetic protons in crystals is reviewed briefly, and the validity of a classical interpretation of the phenomenon is discussed. Experimental results are presented in the form of angular distribution measurements recorded on x-ray film, and energy spectrum measurements made with a collimated semiconductor detector, for protons within the energy range 1 to 5 MeV transmitted by a variety of thin, single crystals. These results are discussed in the light of a model based upon an effective potential due to atomic rows and planes in the lattice. The diffusion of proton trajectories due to elastic scattering processes within the crystal is shown to explain the behaviour of the angular distributions, and the influence upon them of crystal thickness. A distinction is drawn between axial and planar channeling and a barrier is shown to exist between the two types of channel. (auth) (UK)

3595 CORRESPONDENCE PRINCIPLE FOR CHANNELING OF FAST CHARGED PARTICLES. Chadderton, Lewis T. (North American Rockwell Corp., Thousand Oaks, Calif.). Phil. Mag., 18: 1017-31(Nov. 1968).

The transmission of fast charged particles through thin crystals may be considered within the framework of either classical or quantum mechanics. The conditions under which the quantum mechanical diffraction approach attains correspondence with the more familiar classical analysis are discussed by considering only two waves, though a full quantum mechanical discussion requires a multiple beam consideration for the prediction of transmitted intensities. With increasing particle mass m, for a fixed potential of interaction, complementarity may be conveniently visualized in reciprocal space as being achieved when the angular width of the Bragg resonances exceeds the angular separation of the resonances themselves. Inelastic scattering produces a transmission pattern on the exit surface of the crystal of the kind first described by Kikuchi (1928). When correspondence occurs, and this may be determined by comparing the magnitude of a simple dimensionless parameter α with unity, angular widths of lines and bands in the transmission pattern are in a mass-independent limit which is explicable on the basis of Newtonian mechanics and particle orbits. In both the classical and quantum mechanical treatments there is an essential division of the incident collimated beam into two distinctly separate components by the crystal, yielding a "Pendellösung" behaviour which carries over from one analysis to the other. In the diffraction formulation this behaviour is associated with the extinction distance ξ_λ, and in the classical mechanical treatment with the orbit of wavelength λ. (auth) (UK)

3596 RADIATION-PRODUCED ULTRAVIOLET ABSORPTION IN KCl. Garth, J. C.; Sonder, E. (Oak Ridge National Lab., Tenn.). J. Phys. Chem. Solids, 29: 1737-44(Oct. 1968).

Ultraviolet absorption bands produced in KCl by electron irradiation at 80°K to a concentration of 3×10^{18} F centers/cm^3 were studied as a function of trace impurity content and annealing temperature. A single absorption band peaked at 240 nm, reported by Faraday and Compton (1965), was found in samples from three undoped ingots and one lightly lead-doped ingot at the irradiation temperature. After step annealing to higher temperatures new bands of variable width, height, and position were formed which were strongly ingot-dependent. The temperature at which the 240 nm band first showed changes was also sample-dependent. For a more heavily calcium-doped sample, a different initial uv band was found peaked at 230 nm. These bands are attributed to interstitial halide centers which cluster at, and are stabilized by, trace amounts of impurity. (auth) (UK)

3597 ELECTRONIC PROPERTIES OF THE MONOCARBIDE AND MONONITRIDE OF NEPTUNIUM. de Novion, C. H.; Lorenzelli, R. (CEN, Fontenay-aux-Roses, France). J. Phys. Chem. Solids, 29: 1901-5(Oct. 1968). (In French).

The magnetic susceptibility of neptunium monocarbide $NpC_{0.95}$ and mononitride NpN was measured. Both compounds are ferromagnetic at low temperature; the Curie temperatures are, respectively, 190 and 82°K. The monocarbide is probably antiferromagnetic between 190 and 317°K. The paramagnetic moments are, respectively, 3.22 μ_B and 2.13 μ_B. The electrical resistivity of NpN was also measured and a very pronounced anomaly was found near the Curie temperature. The resistivity of NpN decreases slowly at high temperature. (auth)

3598 MAGNETIC CHARACTERISTICS OF $CeAl_3$ AND $CeAl_4$. Mader, K. H.; Swift, W. M. (Univ. of Pittsburgh). J. Phys. Chem. Solids, 29: 1759-64(Oct. 1968).

The magnetic properties of hexagonal $CeAl_3$ and orthorhombic $CeAl_4$ between 2.2 and 300°K are reported and discussed in detail. Both of these compounds exhibited deviations from Curie–Weiss behavior at low temperatures. These deviations are attributed to a combination of crystal field and exchange interactions. Detailed crystal field calculations are presented for $CeAl_3$ which indicate an overall splitting of 280°K. These calculations take into account the compressed nature of the hexagonal lattice in $CeAl_3$, a feature which introduces a second order term into the crystalline potential. Using this model, and making suitable allowances for exchange interactions, it is possible to compute the susceptibility from Van Vleck's equation. The computed and experimental curves agree within 1% over the entire temperature range. Detailed calculations for $CeAl_4$ are not possible at present because of uncertainties in the crystal symmetry; however, the saturation moment of this compound can be attributed to a large crystal field interaction which leaves only the low-lying Kramer's doublet appreciably populated below the transition temperature. (auth) (UK)

3599 SURVEY OF THE FIRST SPECTRUM OF PROTACTINIUM. Richards, E. W. T.; Stephen, I.; Wise, H. S. (Atomic Energy Research Establishment, Harwell, Eng.). Spectrochim. Acta, Part B, 23: 635-42(Oct. 1968).

The emission spectrum of protactinium was measured from 3 μ to 4000 Å. Some 14,000 lines were recorded and about half of these fitted into a level system of some 200 even levels and 300 odd levels. This level system is based on that suggested by Giacchetti (J. Opt. Soc. Amer. 56: 653(1966)), additional levels being confirmed by at least 6 spectral lines. Probable J values are given where possible, and in some cases the limits given in previous work have been reduced. (auth) (UK)

3600 EXCITATION AND EMISSION SPECTRA OF THE BISMUTH-ACTIVATED OXIDES OF SCANDIUM AND YTTRIUM. Boulon, Georges; Janin, Joseph; Gaume-Mahn, Francoise (Univ., Lyon). Compt. Rend., Ser. A and B, 267: 340-3(July 29, 1968). (In French).

The excitation and emission spectra of the Bi^{3+} ion presents analogous maxima in Sc_2O_3 and Y_2O_3. The excitation in the secondary band gives a violet fluorescence. Excited in the doubled principal band, these luminophors emit in the green by the $^3P_1 \rightarrow {}^1S_0$ transition. (tr-auth)

3601 MAGNETIC PROPERTIES OF THE INTERMETALLIC COMPOUNDS OF THE FORMULA T_3Al_2 BETWEEN ALUMINUM AND THE RARE EARTHS. Barbara, Bernard; Becle, Christian; Lemaire, Remy; Pauthenet, Rene (CNRS, Grenoble, France). Compt. Rend., Ser. A and B, 267: 309-12(July 29, 1968). (In French).

The compounds T_3Al_2 are either ferromagnetic or metamagnetic, according to the atom of the alloyed rare earth. The compounds studied were the Gd, Tb, Dy, Ho, Er, and Tm intermetallic compounds. Gd_3Al_2 is ferromagnetic; Tb_3Al_2, Dy_3Al_2, and Ho_3Al_2 are ferromagnetic between the Curie temperature and a transition temperature. Below this temperature they are metamagnetic. Er_3Al_2 and Tm_3Al_2, whatever the temperature, show no spontaneous magnetization in weak field. Below the Neel temperature they are metamagnetic. The variations of the ferromagnetic and paramagnetic Curie temperatures and the variations of the Neel temperatures and transition temperatures were graphed as a function of the atomic number of the rare earth. The graph shows three different regions: a paramagnetic region, a ferromagnetic region, and a region of antiferromagnetic or noncollinear order. (J.S.R.)

3602 ON THE TEMPERATURE DEPENDENCE OF THE MOESSBAUER EFFECT. Mahesh, Krishan (Kurukshetra Univ., India). Nucl. Instrum. Methods, 65: 349-52(Nov. 15, 1968).

The influence of temperature on the recoilless nuclear gamma resonance fraction f is examined in the low- and high-temperature region. A simple interpretation of the variation f with temperature leads to the determination of a threshold characteristic temperature which is related to the observation level of the recoilless fraction. A strong correlation of f with the density of the host material is exhibited through their corresponding temperature variation. (auth)

3603 SPUTTERING AND DEPTH-DISTRIBUTION PHENOMENA. III. ON THE PROBLEM OF DEPTH DISTRIBUTIONS IN OXIDES FOLLOWING HIGH-DOSE LABELINGS. Kelly, R. (McMaster Univ., Hamilton, Ont.). Phys. Status Solidi, 30: 37-48(Nov. 1, 1968).

It has been shown previously that meaningful depth-distribution parameters can be obtained with Al, KCl, and Pt, following high-dose labelings at $\lesssim$10 keV, by sputtering the targets with 2- or 3-keV ions. Similar data are presented for the oxides Al_2O_3, MgO, NiO, SiO_2, and UO_2 labeled to a high dose at 4 keV. It is found that, when the sputtering energy is 2 keV, the implied ion ranges are roughly a factor of 2 less than might be expected (shown with all oxides), while, when the sputtering energy is 8 keV, the implied ranges are smaller still (Al_2O_3, TiO_2). Moreover, shortened ranges are also found by sputtering oxide skins (Al, Mg, Ti), by sputtering bulk materials at about –150°C (Al_2O_3, MgO, UO_2), by applying an anodizing–stripping technique (Al_2O_3), and by comparing high-dose sticking factors (all oxides). It is concluded that the available evidence is compatible with two extreme views. Possibly the shortened ranges found with high-dose labeled oxides are in error, for example due to bombardment-enhanced gas motion when the sputtering technique is used, or due to excess oxide growth when anodizing–stripping is used; alternatively they may be real, as would be true if an effect such as bombardment-enhanced gas motion occurred during the labeling. (auth)

3604 MAGNETIC PROPERTIES OF URANIUM OXYSELENIDE. Murasik, A. (Inst. of Nuclear Research, Otwock, Poland); Suski, W.; Troc, R.; Leciejewicz, J. Phys. Status Solidi, 30: 61-6(Nov. 1, 1968).

UOSe is antiferromagnetic at 4.2°K with a magnetic unit cell twice the size of the chemical one in the c/direction. The magnetic moments are aligned along the c axis, $\mu = (2.21 \pm 0.05)$ Bohr magnetons. The magnetic structure is of the UOS type. The temperature dependence of $1/\chi$ shows a change in the slope at 300°K. The effective moment and the Weiss constant below this point are 2.87 and –10°K, respectively. Above 300°K, the effective moment is 3.30 Bohr magnetons and the Weiss constant –120°K. At 90°K, a maximum occurs on the log ρ against temperature curve. (auth)

3605 TEMPERATURE DEPENDENT SPIN–LATTICE RELAXATION TIMES FOR CONDUCTION ELECTRONS IN LITHIUM PARTICLES IN NEUTRON-IRRADIATED LITHIUM FLUORIDE. Watts, A. J.; Cousins, J. E. (Exeter Univ., Eng.). Phys. Status Solidi, 30: 105-12(Nov. 1, 1968).

Measurements of the conduction–electron spin resonance line widths of Li particles in neutron-irradiated LiF are presented as a function of temperature and at a frequency of 9.27 GHz. A temperature range of 20 to 500°K was covered, and a genuine reversible temperature dependence of the line widths was observed. The results are interpreted in terms of a temperature-dependent surface relaxation mechanism and a temperature–dependent intrinsic one. The latter has a room temperature value of 45 mG which compares favorably with the theoretical prediction of Overhauser. It is shown that the assumptions made for the analysis are compatible with the results of other workers. (auth)

3606 LOW-TEMPERATURE NEUTRON RADIATION DAMAGE AND RECOVERY IN MAGNESIUM. Delaplace, J. (Centre d'Etudes Nucleaires, Grenoble, France); Hillairet, J.; Nicoud, J. C.; Schumacher, D.; Vogl, G. Phys. Status Solidi, 30: 119-26(Nov. 1, 1968).

In neutron-irradiated magnesium at 4.2°K the defect production and subsequent recovery up to 350°K were studied by means of electrical resistivity measurements. Additional experimental evidence is presented from preliminary stored energy, internal friction, and electron microscope studies on neutron-irradiated magnesium, and from electrical resistivity measurements on electron-irradiated magnesium. The principal recovery peak occurs between 90 and 160°K. (auth)

3607 ANTIFERROMAGNETIC ORDERING IN URANIUM MONARSENIDE AND MONOANTIMONIDE. Leciejewicz, J. (Inst. of Nuclear Research, Otwock, Poland); Murasik, A.; Troc, R. Phys. Status Solidi, 30: 157-62(Nov. 1, 1968).

By neutron diffraction it was found that the magnetic structure of UAs at 78°K is of the first kind (A – 1) with a saturation moment of (1.93 ± 0.05) Bohr magnetons. Between 78 and 4°K, there exists

a point of a magnetic phase transition. At 4°K, the magnetic unit cell is doubled in one direction with the moments aligned along the tetragonal unique axis. The sequence of ferromagnetic sheets which are perpendicular to the tetragonal axis, is in the order + − − +. The magnetic moment at 4°K is (2.20 ± 0.05) BM. The magnetic structure of USb both at 4 and 78°K is of the first kind. The values of the saturation magnetic moments at 4 and 78°K are (2.16 ± 0.05) and (2.08 ± 0.05) BM, respectively. (auth)

3608 CRYSTAL FIELD CALCULATION OF PRINCIPAL MAGNETIC SUSCEPTIBILITIES AND ANISOTROPY VARIATION WITH TEMPERATURE OF ANHYDROUS NEODYMIUM CHLORIDE. Taneja, S. P.; Puri, S. P. (Univ. of Roorkee, India). Phys. Status Solidi, 30: 193-7(Nov. 1, 1968).

In the temperature range 5 to 300°K, the principal susceptibilities of single crystals of anhydrous $NdCl_3$ have been calculated on the assumption that a single suitable trigonal field of C_{3h} symmetry exists in the neighborhood of the Nd^{3+} ion. Furthermore, the variation of magnetic anisotropy with temperature is studied and found to increase with the decrease of temperature. The g-values for the lowest level, viz., $g_{||} = 4.103$, $g_{\perp} = 1.746$, compare well with the experimental values obtained from paramagnetic resonance absorption. The following crystal field parameters, reported by Judd, were used in these calculations: $A_2^0\langle r^2\rangle = 103.7$ cm^{-1}, $A_6^0\langle r^6\rangle = -44.51$ cm^{-1}, $A_4^0\langle r^4\rangle = -36.01$ cm^{-1}, $A_6^6\langle r^6\rangle = 426.21$ cm^{-1}. (auth)

3609 DEGRADATION OF LOW-ENERGY ELECTRONS IN ALKALI HALIDES. Itoh, N. (Princeton Univ., N. J.). Phys. Status Solidi, 30: 199-207(Nov. 1, 1968).

The degradation of low-energy electrons in alkali halides is calculated using Gryzinski's cross section and the Monte Carlo method. The stopping power, the extrapolated range, and the degradation spectrum are obtained in the energy range of 100 to 15,000 eV and compared with the results of other theoretical and experimental studies. The yield of double ionization produced by the Auger process and by the direct process is also obtained, and it is shown that the former increases as the energy of the incident electron increases, and the latter decreases as the energy increases above a certain value which is about three times the direct double ionization energy. (auth)

3610 DETERMINATION OF THE AVERAGE NUMBER OF REPLACEMENT COLLISIONS IN AN ELECTRON-IRRADIATED F.C.C. CRYSTAL (Ni_3Mn). Becker, D.; Dworschak, F.; Lehmann, C.; Rie, K. T.; Schuster, H.; Wollenberger, H.; Wurm, J. (Institut fuer Festkoerper- und Neutronenphysik, Juelich, Ger. Technische Hochschule, Aachen). Phys. Status Solidi, 30: 219-29(Nov. 1, 1968).

The electrical resistivity and saturation magnetization damage rates in ordered Ni_3Mn and in pure Ni have been measured during 1.0- and 3.0-MeV electron irradiations at low temperatures. The effect of Frenkel pairs on the damage rates is assumed to be equal in Ni and in Ni_3Mn; thus, the difference between the damage rates merely yields the disordering effect caused by replacement collisions. Changes of the long-range order parameter S then were determined using empirical expressions relating the electrical resistivity and the saturation magnetization to S. Consideration of the relationship between S and the number of replacement collisions in ⟨110⟩ rows yields an average number of (2.2 ± 2.2) replacements per Frenkel pair. This result is discussed in view of experimental recombination volumes and computer experiments. (auth)

3611 FORMATION OF RADIATION DEFECTS BY CHANNELING PARTICLES. Kumakhov, M. A. (Moscow State Univ.). Phys. Status Solidi, 30: 379-85(Nov. 1, 1968).

The problem of interaction of channeling ions with chain nuclei forming the channel is considered. Born–Mayer potentials for Cu–Cu, Moliere, Firsov, and Lindhard potentials are considered as interaction potentials. The energy transferred to the chain nuclei is estimated. In some cases this energy may exceed the threshold energy of atomic displacement. The light channeling ions do not produce displacements. The problem of the influence of the channeling effect on the radiation cascade is also considered. It is shown that this influence is insignificant except for the cases when the initially displaced atoms have high energies. (auth)

3612 DOMAIN BOUNDARIES IN VANADIUM. D'Aragona, F. Secco; Rau, R. C.; Ladd, R. L. (General Electric Co., Cincinnati). Contract AT(40-1)-2847. Phys. Status Solidi, 30: K1-3 (Nov. 1, 1968).

Unirradiated V single crystals of {100} orientation were examined by transmission electron microscopy. Extended fringe defects were observed and are interpreted as domain boundaries which are curved and inclined with respect to the (100) foil plane. Their motion induced by electron-beam heating is described. Possible sources of interstitial impurity atoms in the domains are considered. (D.L.C.)

3613 SEMICONDUCTING PROPERTIES OF POTASSIUM PERMANGANATE. Boldyrev, V. V.; London, G. B.; Zhuravlev, V. K. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Phys. Status Solidi, 30: K13-15(Nov. 1, 1968).

The temperature dependence of the electric conductivity and the thermo-electromotive force was studied for potassium permanganate in the following three states: pure, doped with manganate, and irradiated with 4×10^6 R x rays. The effects of manganate are discussed in terms of the electron concentration. (D.L.C.)

3614 ELEMENTARY MAGNETIC PROPERTIES OF SOME U–Ga COMPOUNDS. Ansorge, V.; Menovsky, A. (Karlova Univ., Prague). Phys. Status Solidi, 30: K31-2(Nov. 1, 1968).

The compounds UGa, UGa_2, and UGa_3 were prepared by reaction of Ga and U metals and annealed. The magnetic susceptibility of UGa_2 and UGa_3 was measured in the temperature range 145 to 290°K. The susceptibility of UGa_3 is independent of the temperature and has the value of 4.35×10^{-6} cgs. UGa_2 obeys the Curie–Weiss law, with a Curie temperature of 126°K. The magnetic moment of UGa_2 was calculated to be 3.12 μ_B, and its magnetization in 9 kG at 77°K was determined to be 22.0 G cm^3/g. (D.L.C.)

3615 ANOMALOUS DUCTILITY OF LiF CRYSTALS AT LOW TEMPERATURES. Okada, T.; Ozawa, K. (Japan Atomic Energy Research Inst., Tokyo). Phys. Status Solidi, 30: K69-71(Nov. 1, 1968).

The plastic behavior of LiF crystals in compression was investigated at temperatures as low as 1.8°K. It was found that LiF crystals can be strained to an amount as large as 9% (ΔL/L) at 4.2°K and 4.5% at 1.8°K. The ductility of KCl and KBr was also studied and found to amount to ~2% strain at 4.2°K. After irradiation by neutrons (3×10^{12} nvt) or gamma rays (2×10^6 r), LiF still retains considerable ductility (>6% at 4.2°K). (D.L.C.)

3616 SELF-INVERSION OF GAMMA LINES. Moessbauer, R. L. (Technische Hochschule, Munich); Seelbach, H. E.; Persson, B.; Bent, M.; Longworth, G. Contract AT(04-3)-63. Phys. Lett., 28A: 94-5(Nov. 4, 1968).

Self-inversion of γ lines has been observed for the first time, using the 14.4-keV transition in ^{57}Fe. This effect provides a new way to determine Debye–Waller factors for recoilless transitions. (auth)

Theoretical Physics

Refer also to abstracts 3661 and 3909.

3617 (AD-671202) CURRENTS AS COORDINATES IN NONRELATIVISTIC QUANTUM MECHANICS. Pardee, W. J.; Schlessinger, L.; Wright, Jon (Illinois Univ., Urbana. Dept. of Physics). June 12, 1968. Contract N00014-67-A-0305. 27p. CFSTI.

The formulation of nonrelativistic quantum mechanics using currents and densities as coordinates is investigated. A general solution for a single particle theory is presented, and several many-body problems are discussed. (auth) (USGRDR)

3618 (ITEF-613) CONNECTION BETWEEN QUANTUM MECHANICS AND LOBACHEVSKY GEOMETRY OF SPACE. Kolkunov, V. A.; Rostokin, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 28p. (In Russian). Dep.

It is shown that approximate solution of the one-dimensional Schroedinger equation, by representing the potential as a set of steps, leads to the concept of multiplicative integral. To analyze the latter, graphical schemes of calculations are developed. In a study of the problem of passage of the waves through the field force, the parametrization of the S matrix through the Euler angles is used, and the connection between the solution of the equation and the Lobachevsky geometry is established. (auth)

3619 (LPTHE-TH-68/16) ASYMPTOTIC BEHAVIOR OF THE NUMBER OF BOUND STATES OF A GIVEN POTENTIAL IN THE LIMIT OF LARGE COUPLING. Chadan, K. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). June 1968. 16p. Dep.

Given a potential V(r), which is assumed to be everywhere positive, nonincreasing as r increases, and for which $\int_0^\infty \sqrt{V(r)}\, dr < \infty$, it is shown that the number of bound states of g V(r) in any angular momentum state ℓ has the asymptotic behavior $n_\ell(g) \sim \pi^{-1} \int_0^\infty \sqrt{V(r)}\, dr \sqrt{-g}$ in the limit $g \to -\infty$. On the basis

of several examples, it seems that the above theorem is valid even if V(r) is only positive, without being everywhere nonincreasing. (auth)

3620 (LPTHE-TH-68/20) TIME DEPENDENCE OF PAIR CORRELATION IN FLUIDS IN TERMS OF SELF DIFFUSION AND STATIC STRUCTURE. Kurkijaervi, Juhani (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). July 1968. 7p. Dep.

An attempt to describe the time dependence of the density–density correlation function of a simple fluid by a simple geometrical argument is presented. Results are compared with computer "experiments." (auth)

3621 (N-68-28824) RESTORATION OF THE ORIGINAL SYNCHROTRON RADIATION FORMULA. Noerdinger, Peter D. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Apr. 1968. 9p. (NASA-CR-95489). CFSTI.

Examples are given to show that under conditions where the radiating electrons are confined to a fixed or slowly expanding region results amending the synchrotron radiation rate equation to replace $H_{\perp}^2$ by H^2 are not applicable. Therefore, the original form of the equation prevails. (auth) (STAR)

3622 QUANTUM TREATMENT OF MULTIPLE REAL TRANSITIONS. Ashley, J. C.; Ritchie, R. H. (Oak Ridge National Lab., Tenn. Univ. of Tennessee, Knoxville). Phys. Rev., 174: 1572-7(Oct. 25, 1968). (ORNL-P-3687).

A quantum-mechanical derivation of the probability that an energetic particle, interacting with an extended many-particle system which possesses a large number of eigenstates lying close together in energy, will excite n of these eigenstates during an interaction time t is given. (auth)

3623 MATRIX METHODS IN QUANTUM MECHANICS. Green, H. S. New York, Barnes and Noble, Inc., 1968. 126p. $2.25.

A realistic historical introduction is given. A systematic development follows, which is an improved version of the method used by the Goettingen school (matrix mechanics). It is mathematically rigorous and general enough to include the approach of de Broglie and Shroedinger. This is achieved with the help of ordinary operator and matrix terminology and notation; the Dirac formalism is explained in an appendix. The physical foundations correspond to Heisenberg's original ideas generalized to include Dirac's relativistic theory. There is a short section on quantum-mechanical paradoxes, which are discussed with the help of a sharp distinction between the indeterminate and the uncertain. (M.H.R.)

3624 SCHWINGER'S ANGULAR-MOMENTUM CALCULUS AND THE DIRAC BRACKET. Gyoergyi, G. (Institute de Physique Nucleaire, Orsay, France); Koevesi-Domokos, S. Nuovo Cim., 58B: 191-200(Nov. 11, 1968).

It is shown that canonical quantization of the rigid rotator, according to the procedure proposed by Dirac for systems subject to constraints, naturally leads to Schwinger's representation of angular momentum. The de Sitter dynamical group $SO_{3,2}$ serves as a framework of the treatment. (auth)

3625 THE CALCULATION OF SOME STATES BEGINNING WITH A KLEIN–GORDON EQUATION. Avramesco, Andre. Compt. Rend., Ser. A and B, 267: 497-9(Sept. 2, 1968). (In French).

The Schroedinger equation can be considered either as a simple condition which should verify the Ψ waves or as a true propagation equation. If it is considered as the latter, an initial space–time localization of a physical phenomenon will be conserved with time, at least in the relativistic case, in the measure where a maximum propagation velocity limits by a "front" the support of the wave function. A support extended to all space can be conceived then only with the convergence (asymptotic) of a transitory process. The calculations given have the purpose of furnishing, on an elementary example, a scheme of such a process: they analyze the separation between the permanent term and the transitory term in this particular case. (tr-auth)

3626 REDUCED DENSITY MATRICES OF THE ANISOTROPIC HEISENBERG MODEL. Ginibre, J. (New York Univ., N. Y.). Commun. Math. Phys., 10: 140-54(Oct. 3, 1968).

The reduced density matrices of the anisotropic Heisenberg model are studied by means of a functional integral representation based on a generalized Poisson process. Integral equations, which are analogous to the classical Kirkwood–Salzburg equations, are then used to prove the existence of the infinite volume limit of the reduced density matrices, analyticity properties with respect to the fugacity (or magnetic field) and the potentials, and a cluster property, in the low-fugacity (high magnetic field) region. (auth)

3627 CHERENKOV RADIATION IN A PERIODIC LAMINAR DIELECTRIC. Casey, K. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Can. J. Phys., 46: 1957-66(Sept. 1, 1968).

The electromagnetic field produced when a charged particle traverses a periodic laminar dielectric medium in a direction normal to the laminations is determined. The field is the sum of an infinite number of the normal modes of the structure. The conditions under which the individual modes are radiative are discussed, and expressions for the field components and energy spectral densities of the modes are obtained. Numerical examples illustrate the behavior of the spectral densities and emission angles of the various modes with respect to the particle velocity and the degree of inhomogeneity of the medium. It is found that the total energy spectral density of the radiation is nearly equal to that of Cherenkov radiation in a homogeneous medium. The principal effect of the periodicity of the medium is to cause the emission to occur at several angles with respect to the direction of travel of the particle. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 3656 and 3659.

3628 (NYO-1984-12) HIGH-ENERGY PHYSICS AT TUFTS UNIVERSITY. Annual Progress Report. Knipp, Julian K. (Tufts Univ., Medford, Mass. Dept. of Physics). Oct. 1968. Contract AT(30-1)-1984. 47p. Dep. CFSTI.

The present status of the research and development program at Tufts University is described including nuclear emulsions, bubble chambers, nuclear physics, high energy photons (including lasers and proton polarization in neutral pion photoproduction), and theoretical research. A list of publications is also presented. (W.H.K.)

3629 (UH-511-35) ANNUAL PROGRESS REPORT OF THE HIGH ENERGY PHYSICS GROUP. (Hawaii Univ., Honolulu. Dept. of Physics and Astronomy). Sept. 30, 1968. Contract AT(04-3)-511. 64p. Dep. CFSTI.

A brief summary of the experimental and theoretical programs at Hawaii University are presented. Spark chamber experiments, bubble chamber experiments, research staff, publications and talks, hardware and software support, and computer development are discussed. Topical conferences in particle physics, consultants and theory visitors, and theoretical work are also discussed. (W.H.K.)

Electromagnetic

Refer also to abstracts 3653, 3806, and 3936.

3630 PI-PAIR PHOTOPRODUCTION BELOW 850 MeV. Palazzi, G. Diambrini (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa); Sette, G.; Giannini, I.; Grianti, F.; Santroni, A. Phys. Rev. Lett., 21: 1463-5(Nov. 11, 1968).

Preliminary results of an experiment on double-pion photoproduction with spark chamber and counter techniques below 1 GeV are reported. Proton angular and (p,π^+) invariant-mass distributions at fixed π^- momentum are given. Comparison with the expected values computed by the isobaric model is shown. (auth)

3631 POSITRON-ELECTRON SCATTERING AND BHABHA EXCHANGE EFFECTS. Mendiratta, R. G. (Indian Inst. of Tech., New Delhi). Can. J. Phys., 46: 2539-42(Nov. 15, 1968).

The study of positron–electron scattering is made using a Wilson cloud chamber to check the presence of Bhabha exchange effects. The observed scattering cross section is more than the value calculated from Moller's theory of positron–electron scattering, where only the Coulomb interaction between the particles is considered. However, the experimental results are in good agreement with the theory if the exchange effects suggested by Bhabha are also included. (auth)

3632 PROTON COMPTON EFFECT BY POLARIZED PHOTONS AT 90° IN THE c.m. SYSTEM IN THE FIRST RESONANCE REGION. Barbiellini, G.; Capon, G.; DeZorzi, G.; Murtas, G. P. (CNEN, Rome). Phys. Rev., 174: 1665-73(Oct. 25, 1968).

For the reaction $\gamma + p \rightarrow \gamma' + p'$ (proton Compton effect), the ratio $d\sigma_{||}/d\sigma_{\perp}$ between the cross sections for linearly polarized photons was measured, using the coherent bremsstrahlung beam of the Frascati electron synchrotron. At 90° in the cm system and in the photon energy region $300 \leq K \leq 335$ MeV, $d\sigma_{||}/d\sigma_{\perp} = 2.1^{+0.8}_{-0.5}$. In the absence of theoretical predictions based on the dispersive theory in this energy region, this result is compared with the values obtained using an isobaric model, taking into account various possible intermediate states. (auth)

3633 PROTON–PROTON BREMSSTRAHLUNG AT 99 MeV. Sannes, F.; Trischuk, J.; Stairs, D. G. (McGill Univ., Montreal). Phys. Rev. Lett., 21: 1474-6(Nov. 18, 1968).

Measurements of the proton–proton bremsstrahlung cross section $d\sigma/d\Omega_1 d\Omega_2$ at 99 MeV are reported. Cross sections of 3.77 ± 0.23, 5.14 ± 0.22, 9.01 ± 0.33, and 18.83 ± 1.15 $\mu b/sr^2$ were obtained at angles of 25°, 30°, 35°, and 40°, respectively. The angular distributions of the photons were determined kinematically. The results agree generally but not in detail with theoretical predictions. (auth)

3634 DECAY $\eta \rightarrow \pi^+\pi^-\pi^0$ AND THE s-WAVE $\pi\pi$ PHASE SHIFT. Litchfield, P. F. (Rutherford High Energy Lab., Chilton, Eng.). Nuovo Cim., 58A: 468-74(Nov. 21, 1968).

The structure in the decay $\eta \rightarrow \pi^+\pi^-\pi^0$ was investigated for a sample of 879 events under the assumption that only a single $\pi\pi$ scattering in the final state is important. The η branching ratios indicate that the lowest s-wave state of the three pions is dominant. The σ-resonance model of the decay appears to be inconsistent with other evidence on the low-energy $\pi\pi$ system. The structure is well fitted by an s-wave $\pi\pi$ phase shift that rises approximately linearly from threshold to 30° at a $\pi\pi$ mass of 400 MeV/c^2. (auth)

3635 TRANSITION RADIATION FROM RELATIVISTIC CHARGED PARTICLES PASSING ALUMINUM AND SILVER FOILS. Pruenster, S.; Wang, C. L.; Yuan, L. C. L.; Oostens, J. (Brookhaven National Lab., Upton, N. Y.). Phys. Lett., 28B: 47-50(Oct. 28, 1968).

Transition radiation in the optical region from individual protons and pions, as well as from electrons in the relativistic energy region was obtained from aluminum and silver foils. The intensity increases logarithmically with the particle energy in agreement with theory. (auth)

Weak

3636 A MEASUREMENT OF THE RATIO OF THE DECAY RATES $K_L^0 \rightarrow 2\gamma/K_L^0 \rightarrow 3\pi^0$. Arnold, R. (CERN, Geneva); Budagov, I. A.; Cundy, D. C. (and others). Phys. Lett., 28B: 56-7(Oct. 28, 1968).

Using a heavy-liquid bubble chamber, the ratio of the decay rates $K_L^0 \rightarrow 2\gamma/K_L^0 \rightarrow 3\pi^0$ has been determined to be $(2.5 \pm 0.7) \times 10^{-3}$. (auth)

3637 MEASUREMENT OF THE BRANCHING RATIO AND POSITRON MOMENTUM SPECTRUM FOR THE DECAY $K^0 \rightarrow \pi^0 + e^+ + \nu$. Botterill, D. R.; Brown, R. M.; Clegg, A. B. (and others). (Nuclear Physics Lab., Oxford). Phys. Rev., 174: 1661-4(Oct. 25, 1968).

The branching ratio and positron momentum spectrum were measured for the K_{e3}^+ decay mode. The shape of the momentum spectrum, containing 17,000 events, is consistent with pure vector coupling with a form-factor momentum dependence given by $\lambda^+ = 0.08 \pm 0.04$. Upper limits on a possible mixture of scalar or tensor coupling are, respectively, $|f_s/f_+| < 0.23$ and $|f_T/f_+| < 0.58$. The branching ratio is found to be (4.92 ± 0.21)%, based on 960 events. The semileptonic $\Delta I = 1/2$ rule is tested by comparing the K_{e3}^+ and K_{e3}^0 rates. It is concluded that the present data on K_{e3} decays are in disagreement with this rule. (auth)

3638 UPPER LIMIT ON THE DECAY RATE $K_L^0 \rightarrow \pi^+\pi^-\gamma$. Thatcher, R. C.; Abashian, A.; Abrams, R. J.; Carpenter, D. W.; Mischke, R. E.; Nefkens, B. M. K.; Smith, J. H.; Verhey, L. J.; Wattenberg, A. (Univ. of Illinois, Urbana). Phys. Rev., 174: 1674-80(Oct. 25, 1968).

A search was made for the decay mode $K_L^0 \rightarrow \pi^+\pi^-\gamma$. The charged decay products were momentum-analyzed in a magnet and identified in a set of range-shower spark chambers. The position of the γ-ray conversion point in these chambers was compared with the position predicted on the hypothesis of $K_L^0 \rightarrow \pi^+\pi^-\gamma$. The $K_{\pi 3}$ provided almost the sole background as well as the normalization of our rate measurement. In 962 events with good γ-ray showers one event fitted the $\pi\pi\gamma$ hypothesis within spatial resolution. However, the expected background was one event. This result corresponds to an upper limit on the decay rate $R(K_L^0 \rightarrow \pi^+\pi^-\gamma) \leq 7.5 \times 10^3$ sec^{-1} at a confidence level of 90%. The result is compared with the predictions of various theoretical models. The possible connections to other decay processes ($K^\pm \rightarrow \pi^\pm\pi^0\gamma$, $K_L^0 \rightarrow \pi^0\pi^0\gamma$, $K_S^0 \rightarrow \pi^+\pi^-\gamma$) and tests of CP invariance are discussed. (auth)

3639 EXPERIMENTAL STUDY OF THE DECAY $K_L \rightarrow \pi^+\pi^-\pi^0$. Basile, P.; Cronin, J. W.; Thevenet, B.; Turlay, R.; Zylberajch, S.; Zylbersztejn, A. (CEN, Saclay, France). Phys. Lett., 28B: 58-60(Oct. 28, 1968).

From a sample of 2446 $K_L^0 \rightarrow \pi^+\pi^-\pi^0$ decays the study of pion energy spectra according to the squared matrix element $|M|^2 \propto [1 + 2a_0(2T_0 - T_{max}) M_K/m_\pi^2]$ where T_0 is the π^0 kinetic energy, is presented. We find $a_0 = -0.188 \pm 0.020$; this value is compared with the $|\Delta I| = 1/2$ rule selection. (auth)

Strong (Baryon-Induced)

Refer also to abstracts 3647 and 3931.

3640 BUBBLE-CHAMBER STUDY OF PROTON–PROTON COLLISIONS AT 4 GeV/c. II. MULTIPLE PION PRODUCTION.

Bodini, L. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan); Case, L.; Kidd, J.; (and others). Nuovo Cim., 58A: 475-99(Nov. 21, 1968).

About 50,000 pictures were taken in the 81 cm Saclay hydrogen bubble chamber exposed at the CERN Proton-Synchrotron to a separated beam of 4 GeV/c incident momentum protons. Cross-sections for the various channels for multiple pion production are reported, as well as production cross-sections for baryon and boson resonances, taking into account the peripheral behavior of the interaction in the evaluation of the background. All the channels appear to be dominated by the N^*_{1236} isobar production, while the presence of higher isobars does not seem to affect appreciably the general features of the different reactions. The only clear evidence among the boson resonances is for $\eta(\sigma_\eta = (0.04 \pm 0.02)$ mb) and ω ($\sigma_\omega = (0.08 \pm 0.03)$ mb). There is no strong evidence for the I = 5/2 isobar around 1.58 GeV/c^2. Finally an analysis of reactions producing more than one neutral particle has been tried, allowing an estimate of the mean multiplicities for both charged and uncharged pions. (auth)

3641 STRUCTURE IN THE ANGULAR DISTRIBUTION OF HIGH ENERGY PROTON–PROTON SCATTERING. Allaby, J. V.; Binon, F.; Diddens, A. N. (and others). (CERN, Geneva). Phys. Lett., 28B: 67-71(Oct. 28, 1968).

Results are presented on measurements of elastic proton-proton scattering at 19.2 and 21.1 GeV/c in the angular region where previously structure had been observed at lower energies. (auth)

Strong (Meson-Induced)

Refer also to abstract 3634.

3642 (UR-875-254) K^+p AND K^-p BACKWARD SCATTERING IN THE ENERGY REGION FROM 1.0 TO 2.5 GeV/c. Carroll, A. S.; Fischer, J.; Lundby, A. (and others) (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Aug. 26, 1968. Contract AT(30-1)-875. 30p. (CONF-680809-33). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

The wire spark chamber system is described, and the angular distributions for K^+p and K^-p backward elastic scattering are presented. Also, the possibility of resonances in the K^+p and K^-p systems is investigated. (W.H.K.)

3643 TEST OF QUARK-MODEL PREDICTIONS IN DOUBLE RESONANCE PRODUCTION BY 5 GeV/c π^+ MESONS ON PROTONS. Boeckmann, K. (Univ., Bonn. Kernforschungsanlage, Juelich, Ger.); Rost, M.; Sternberger, K.; (and others). Phys. Lett., 28B: 72-6(Oct. 28, 1968).

The joint-decay statistical tensors for π^+p production of $N^*\rho$ and $N^*\omega$ at 5 GeV/c are given. A comparison with the Bialas–Zalewski quark-model predictions indicates full agreement in the $N^*\rho$-channel but only partial agreement in the $N^*\omega$-channel. (auth)

3644 CONFIRMATION OF AN ENHANCEMENT IN THE $\pi^-\pi^+$ SYSTEM AT M = 1.05 GeV. Miller, D. H.; Gutay, L. J.; Lichtman, S.; Loeffler, F. J.; Miller, R. J.; Willmann, R. B. (Purdue Univ., Lafayette, Ind.). Phys. Lett., 28B: 51-5(Oct. 28, 1968).

In analysis of 7733 events of the type $\pi + N \rightarrow N + \pi^- + \pi^+$ at 2.7 GeV/c the existence of a $\pi\pi$ enhancement with a mass of 1.05 ± 0.01 GeV has been confirmed. The width is ≤0.08 GeV and a production cross section of 40 ± 10 μb is observed. I = 0 is preferred and I is consistent with 0 or 2. (auth)

3645 SPIN–PARITY ANALYSIS OF THE LOW-MASS (1.1–1.4 BeV) $K^*\pi$ SYSTEM IN $K^-p \rightarrow \overline{K}^{*0}\pi^-p$ AT 5.5 BeV/c. Park, J. C.; Kim, S. (Univ. of Illinois, Urbana). Phys. Rev., 174: 2165-7(Oct. 25, 1968).

A method of spin-parity analysis is suggested and applied to low-mass $K^*\pi$ systems in $K^-p \rightarrow \overline{K}^{*0}\pi^-p \rightarrow K^-\pi^+\pi^-p$ at 5.5 BeV/c. It is found that the $K^*\pi$ system in each of the mass regions 1.1–1.2, 1.2–1.3, and 1.3–1.4 BeV is consistent only with $J^P = 1^+$. The corresponding density-matrix elements, the strength of the K^*-helicity-0 component, and that of the S-wave component are then determined. (auth)

3646 pp INTERACTIONS AT 10 GeV/c. Almeida, S. P. (Cambridge Univ., Eng.); Rushbrooke, J. G.; Scharenguivel, J. H.; (and others). Phys. Rev., 174: 1638-61(Oct. 25, 1968).

About 3700 two-prong and 5600 four-prong events of 10-GeV/c pp interactions in the Saclay 81-cm hydrogen bubble chamber were measured and analyzed. The reliability of the identification of the different final states was checked using Monte Carlo-generated events. For the channels accessible to analysis, cross sections and invariant-mass distributions are given. The cm angular distributions and the mean values of the transverse momentum for all final-state particles are shown and discussed. Production of $\Delta^{2+}(1236)$ accounts for about 30% of the cross section $\sigma(pp \rightarrow pn\pi^+) = 4.1 \pm 0.4$ mb. About 50% of the cross section $\sigma(pp \rightarrow pp\pi^+\pi^-) = 2.4 \pm 0.2$ mb can be accounted for by Δ^{2+} production. Production of nucleon isobars at 1450, 1520, and 1730 MeV and their subsequent decay into $p\pi^+\pi^-$ are investigated. Their cross sections, t dependences, and branching ratios are determined, using a one-pion-exchange model (OPEM) for calculating the background distributions. The production of resonances decaying into $p\pi^-$ at 1236, 1500, and 1690 MeV is seen, and cross sections are given. Resonance production in the $pp\pi^+\pi^-\pi^0$ and $pn\pi^+\pi^+\pi^-$ reactions is studied using the background curves calculated with a model based on simple parametrizations of the cm momentum distributions. The production of nucleon isobars accounts for nearly 100% of these reactions. For the reactions $pp \rightarrow pp\omega$, $pp\eta$, and $pp\eta^0$, the cross sections found are 0.16 ± 0.03, 0.16 ± 0.07, and 0.10 ± 0.04 mb, respectively, corrected for unobserved decay modes. It is shown that most of the gross features of the pion-production reactions can be explained by the OPEM with the form factors of Ferrari and Selleri. (auth)

3647 ELASTIC SCATTERING OF π^-, K^- AND $\bar{p}$ FROM PROTONS AT 9.8 AND 13.6 GeV/c. Orear, J. (Cornell Univ., Ithaca, N. Y.); Owen, D. P.; Peterson, F. C.; Read, A. L.; Ryan, D. G.; White, D. H.; Ashmore, A.; Damerell, C. J. S.; Frisken, W. R.; Rubinstein, R. Phys. Lett., 28B: 61-3(Oct. 28, 1968).

Measurements have been made of the differential cross section for π^--p elastic scattering at 9.8 GeV/c in the angular range 25–120° cms. Together with existing data, an almost complete angular distribution has now been obtained at this momentum. Measurements have also been made over more restricted angular ranges for 9.7 GeV/c K^--p and $\bar{p}$-p elastic scattering and 13.6 GeV/c π^--p and K^--p elastic scattering. (auth)

3648 DETERMINATION OF THE SIGN OF THE AMPLITUDE FOR $\pi^+\pi^-$ SCATTERING. Aref'ev, A. V.; Bayukov, Yu. D.; Zaitsev, Yu. M.; Kuleshov, V. A.; Leksin, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 631-2(Sept. 1968). (In Russian).

The cross section and $\pi^+\pi^-$ scattering amplitude modulus $|a_1|$, were determined using $\pi^- + p \rightarrow \pi^- + \pi^+ + \eta$ reaction at weak pulse transmission to nucleon. Previously, it was found that the modulus $|a_1|$ varied slightly in the range of small ω and $|a_1| = 0.95 \pm 0.20$ at $\omega = 2$ (ω is the mass of dipole systems) all magnitudes are given in the pion mass units. An attempt was made to determine the sign a_1 using the energy function $\delta_{\pi^+\pi^-}$ and considering that pion–pion scattering at small δ is described by effective radius approximations. The obtained magnitude $|a_1| = -0.88 \pm 0.05$ and $a_1'' = -1.13 \pm 0.22$ do not differ much from the magnitude of $|a_1|$ obtained previously. The obtained magnitudes $r' = 1.78 \pm 0.22$ and $r'' = 0.72 \pm 0.62$ appear to hold also. Considering that $a_1 = 2a_0 + a_2$ (a_2 is the amplitude of pion–pion scattering with isospin T = 2) it is possible to determine the sign a_0 which is the amplitude of pion–pion interaction in pure isotopic state T = 0. Also, considering that $|a_2| < |a_0|$, we obtain $a_0 < 0$. (R.V.J.)

3649 ANALYSIS OF REACTIONS $\pi + N \rightarrow \pi + \pi + N$ AT T_π = 350 to 600 MeV. DETERMINATION OF THE TRIANGLE GRAPH CONTRIBUTION AND ESTIMATE OF THE $\pi\pi$-SCATTERING AMPLITUDE AT LOW ENERGIES. Anisovich, V. V.; Levin, E. M.; Likhoded, A. K.; Stroganov, Yu. G. (Serpukhov Inst. of High-Energy Physics, USSR). Yadern. Fiz., 8: 583-99 (Sept. 1968). (In Russian).

The reactions $\pi + N \rightarrow \pi + \pi + N$ at T_π = 350 to 600 MeV are analysed assuming the dependence of various partial amplitudes on the initial energy and on the energy of particles produced to be determined by the singularities near to the physical region only. The data on the phase-shift analysis of the pion-nucleon scattering were substantially used. The estimate of singular part of the triangle graph allows one to determine the $\pi\pi$-scattering amplitude at low energies. The experimental data are in agreement with the assumption that the π-meson scattering length a_0 is of the order of –1 or 0 (in units $\hbar/m_\pi c$). The best agreement is obtained at $a_0 \approx -1$; at $a_0 \approx 1$ there is a sharp disagreement with the experimental data on pion spectra in the reaction $\pi^-p \rightarrow n\pi^+\pi^-$. Experiments are discussed which enable one to estimate more accurately the contribution of singular part of the triangle graph. (auth)

3650 INVESTIGATION OF SPIN AND PARITY OF A_2 MESON. Vladimirskii, V. V.; Vasil'eva, O. N.; Lomkatsi, G. S.; Tikhomirov, G. D. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 507-12(Sept. 1968). (In Russian).

A new method to determine the spin and parity of resonances decaying into 3π mesons is described. The method proposed is used to determine the spin and parity of A_2 meson produced in the reaction $\pi^-p \rightarrow p\pi\rho$. (auth)

3651 K^+d PARTIAL CROSS SECTIONS AROUND 1 GeV/c. Hirata, Allan A.; Wohl, Charles G.; Goldhaber, Gerson; Trilling, George H. (Univ. of California, Berkeley). Phys. Rev. Lett., 21: 1485-8(Nov. 18, 1968).

Partial cross sections for K^+d and isospin-0 KN scattering around 1 GeV/c are presented. (auth)

3652 STUDY OF AN $I = 0$ $\pi^-\pi^+$ RESONANCE AT A MASS OF 1.06 GeV. Miller, D. H. (Purdue Univ., Lafayette, Ind.); Gutay, L. J.; Johnson, P. B.; Kenney, V. P.; Guiragossian, Z. G. T. Phys. Rev. Lett., 21: 1489-93(Nov. 18, 1968).

A resonance in the $\pi^-\pi^+$ final state with $I = 0$, $M = 1.06 \pm 0.015$ GeV, and $\Gamma < 0.07$ GeV has been observed. Analysis favors $l \geq 2$. It is produced primarily at a four-momentum transfer squared less than 0.1 GeV^2, and observed most clearly in the region where the cosine of the $\pi\pi$ scattering angle is less than -0.75. (auth)

3653 LEPTONIC DECAYS OF VECTOR MESONS: THE BRANCHING RATIO OF THE ELECTRON–POSITRON DECAY MODE OF THE PHI MESON. Becker, U.; Bertram, William K.; Binkley, M.; Jordan, C. L.; Knasel, T. M.; Marshall, R.; Quinn, D. J.; Rohde, M.; Smith, A. J. S.; Ting, Samuel C. C. (Deutsches Elektronen-Synchrotron, Hamburg). Phys. Rev. Lett., 21: 1504-7(Nov. 18, 1968).

An experiment designed to measure the branching ratio of the phi meson to e^+e^- was performed at DESY by measuring phi production and phi decay to e^+e^- with the same apparatus. The results of this experiment, based on 10^4 $\varphi \rightarrow K^+K^-$ events and 41 $\varphi \rightarrow e^+e^-$ events on carbon, yield a branching ratio of $(2.9 \pm 0.8) \times 10^{-4}$. This result is compared with various theoretical predictions. (auth)

3654 CHARGED ρ PRODUCTION IN ASSOCIATION WITH Δ^0 IN π^+d INTERACTIONS AT 5 GeV/c. Ghidini, B. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy); Picciarelli, V.; Quareni-Vignudelli, A.; Cartacci, A.; Mettel, D.; Quinquard, J.; Vanderhagen, R.; Goldberg, M.; Makowski, B. Nuovo Cim., 58A: 524-30(Nov. 21, 1968).

The study is based on analysis of pictures of the Saclay 81 cm bubble chamber filled with deuterium and exposed at the CERN PS. The interactions $\pi^+ + d \rightarrow p_s + p + \pi^- + \pi^0 + \pi^+$ at 5.1 GeV/c and $\pi^- + d \rightarrow p_s + p + \pi^- + \pi^- + \pi^0$ at 5.04 GeV/c were studied. Mass distributions, production differential cross sections, and decay analysis for $\rho^\pm\Delta^0$ associated production are presented. (W.H.K.)

3655 OBSERVATION AND ANALYSIS OF THE 1660 MeV 3π-RESONANCE "A_3" IN 8 GeV/c π^+p INTERACTIONS. Bartsch, J. (Technische Hochschule, Aachen); Keppel, E.; Kraus, G.; (and others). Nucl. Phys., B7: 345-54(1968).

The production of the 1660 MeV 3π-resonance called the A_3 is studied in 8 GeV/c π^+p interactions. Its mass and width are found to be (1660 ± 16) MeV and (115 ± 45) MeV, respectively. The cross section for $\pi^+p \rightarrow p\,A_3^+ \rightarrow p(\pi^+\pi^+\pi^-)$ is found to be (46 ± 15) μb. The differential cross section has a slope of (5.5 ± 0.6) GeV^{-2}. The spin-parity values are found to be most probably in the series $0^-, 1^+, 2^-, 3^+ \ldots$, while the isospin is one and the G-parity is odd. Branching ratios into (3π) and (πf^0) are given for different spin-parity values, while the $(\pi\rho)$ decay rate is found to be consistent with zero. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 3628, 3629, and 3841.

3656 (AED-C-23-30) HIGH ENERGY PHYSICS INDEX. Volume 6, No. 9 (5188–6248). (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 376p. Dep.

A monthly report of theoretical and experimental high-energy physics material received at DESY such as periodicals, books, conference proceedings, reports, and preprints is presented. An author index, preprint and report number index, and subject index are included. (W.H.K.)

3657 (IC-68/87) FUNDAMENTAL THEORY OF MATTER: A SURVEY OF RESULTS AND METHODS. Salam, Abdus (International Centre for Theoretical Physics, Trieste (Italy)). Sept. 1968. 78p. (CONF-680637-1). Dep.

From International Symposium on Contemporary Physics, Vienna, Austria.

A survey is given of the fundamentals of particle physics, with emphasis on the present knowledge and methods. The Rosenfeld table of stable and semi-stable particles and resonances are discussed, introducing at the same time the various classifying charges. The theoretical apparatus used are then described, and principles of relativistic quantum mechanics are reviewed. The dynamical role of charges and other dynamical symmetries not associated with charges are considered. Some speculations are given on whether these symmetries foreshadow discovery of newer forms of matter interacting with super-strong forces. (L.B.S.)

3658 (JINR-E2-4030) RELATIVISTIC THREE-DIMENSIONAL EQUATIONS FOR THE TWO-BODY PROBLEM IN THE UNEQUAL MASS CASE. Kadyshevskii, V. G.; Mateev, M. D.; Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 22p. Dep.

Three-dimensional relativistic equations of quasipotential type were obtained for a system of two particles with masses m_1 and m_2. These equations are generalizations of the corresponding Lippmann-Schwinger and Schrödinger equations in the spirit of a Lobachevsky geometry, realized on the hyperboloid $p_0^2 - \vec{p}^2 = m_1 m_2$. The concept of relativistic relative momentum, expressed in terms of the reduced mass and the relativistic relative velocity of the particles, plays an important role. (Auth)

3659 (RLO-2041-19) ANNUAL REPORT [ON HIGH-ENERGY PHYSICS], 1967–68. Moravcsik, Michael J. (Oregon Univ., Eugene. Inst. of Theoretical Science). Oct. 31, 1968. Contract AT(45-1)-2041. 7p.

High-energy physics research at the University of Oregon is briefly described. Topics include Regge poles, nondynamical properties of reactions, dynamical models, mass splittings, special reactions, and general particle theory. (W.H.K.)

3660 INTERACTION ANGULAR MOMENTUM. Cooke, James H. (Univ. of Manitoba, Winnipeg). Phys. Rev., 174: 1602-6(Oct. 25, 1968).

A basic assumption of scattering theory is that the particles are asymptotically free. However, Van Dam and Wigner have recently shown that, for the important case of electromagnetic coupling, the angular momentum of the particles never assumes its free form (that of a constant tensor). Such effects are investigated in classical mechanics and quantum field theory. It appears that they do not invalidate current experimental technique for angular momentum determinations. They are of interest in the general problem of asymptotic values. (auth)

3661 MEASURABILITY OF THE SPIN DENSITY MATRIX. Newton, Roger G.; Young, Bing-lin (Indiana Univ., Bloomington). Ann. Phys. (N. Y.), 49: 393-402(Oct. 1, 1968).

The spin density matrix for particles of arbitrary intrinsic angular momentum is explicitly expressed in terms of directly measurable quantities. The latter are taken to be either expectation values of components of multipole moments, or the relative weights of partial beams split-up by a Stern–Gerlach apparatus according to eigenvalues of dipole projections in several directions. (auth)

3662 APPLICATION OF DISTRIBUTIONS TO THE THEORY OF ELEMENTARY PARTICLES IN QUANTUM MECHANICS. Schwartz, Laurent. Documents on Modern Physics. New York, Gordon and Breach, Science Publishers, 1968. 142p.

The set of the universal particles and its structure, universal particles and the translation invariance: kernel simplification, elementary particles and the Lorentz invariance, spin particles, and the definition of some physical notions are discussed. (W.H.K.)

3663 BASIC COMMUTATION RELATION FOR CURRENT DIVERGENCES. Campbell, D. K. (Cambridge Univ., Eng.). Nuovo Cim., 58A: 547-50(Nov. 21, 1968).

A derivation of the equation for current divergences $\partial_\mu j^{\mu c}(x) = i[H_{00}(x), Q^c(t)]$ is presented which follows straightforwardly from the canonical commutation relations. (L.B.S.)

3664 CORRELATION BETWEEN TRANSCENDENTAL AND POLYNOMIAL LAGRANGIANS. Fried, H. M. (Brown Univ., Providence). Phys. Rev., 174: 1725-30(Oct. 25, 1968). (NYO-2262TA-181).

A calculational procedure is defined to permit the computation of radiative corrections for nonderivative transcendental interactions. The method, a generalization of the Fradkin iterative procedure, is guaranteed to maintain the correct analyticity structure of at least the lowest-order corrections, and suggests a correlation between transcendental and conventional polynomial interactions, along with simple conditions for equivalence. A class of chiral models, treated in this sense and tested in an approximate way which partially violates the chiral symmetry, appears to be dynamically empty under this equivalence. (auth)

Electromagnetic

Refer also to abstracts 3684, 3692, 3722, 3759, and 3778.

3665 (BMwF-FBK-68-26) AN EXAMPLE OF THE INFLUENCE OF THE MASS OPERATORS IN THE BHABHA EQUATION. Stoeve, R. (Muenster Univ. (West Germany). Institut fuer Theoretische Physik). June 1968. 2p. (In German). Dep.

The quantity $\varkappa$ in the Bhabha equation $(\delta_k\beta_k + \varkappa)\psi = 0$ is a Lorentz invariant operator. With suitably chosen commutators $[\beta_k, \beta_l]$ the operator β_k and the nucleus of the Lorentz group span a Lie algebra, in the adjoint representation of which the Bhabha equation with special $\varkappa$ describes the electromagnetic field. (auth)

3666 RADIATIVE CORRECTION TO PION PHOTOPRODUCTION. Picciotto, Charles; Krass, Allan S. (Univ. of California, Santa Barbara). Phys. Rev., 174: 2109-12(Oct. 25, 1968).

The radiative corrections are studied for π^+ photoproduction off nucleons for the process of single-pion exchange. It is assumed that the nucleon is not appreciably disturbed by the reaction so that inelastic photons come only from the exchanged and external pions. In order to make the problem gauge-invariant the exchanged pion is taken on its mass shell for the $\pi^+\gamma\pi^+$ calculation. It is found that the corrections do not significantly enhance the forward differential cross section, and are not important for present experiments at larger angles. (auth)

3667 RARE DECAY MODE $\eta \to \pi^+\pi^-\pi^0\gamma$ AND THE RELATION BETWEEN VECTOR-DOMINANCE AND CURRENT-ALGEBRA CALCULATIONS. Chatterjee, Aruna (Univ. of Delhi). Phys. Rev., 174: 1832-5(Oct. 25, 1968).

The decay rate for $\eta \to \pi^+\pi^-\pi^0\gamma$ was calculated when the photon is emitted in the M1 state. Since for such a transition the three pions are in a $3^P = 1^-$ and I = 0 state, the ω-meson-dominant calculation is expected to give a reasonable estimate of the rate of the $\eta \to \pi^+\pi^-\pi^0\gamma$ decay mode. Further, comparison of the vector-meson-dominant result with that obtained by applying current commutation relations predicts that these two results are equivalent, provided the Kawarabayashi–Suzuki relation $g_{\omega 3\pi} = 3\mu^2 F_\pi^{-2} g_{\omega\pi\gamma}$ is valid when $g_{\omega 3\pi}$ and $g_{\pi\omega\gamma}$ are the coupling constants in $\omega \to 3\pi$ and $\omega \to \pi\gamma$ decays. The ω-meson-dominant calculation together with the Kawarabayashi–Suzuki relation predicts $\Gamma(\eta \to \pi^+\pi^-\pi^0\gamma)/\Gamma(\eta \to \pi^0 2\gamma) = 0.2\%$, in reasonable agreement with experiment. (auth)

3668 CURRENT ALGEBRA AND DOUBLE-PION PHOTOPRODUCTION. Bhargava, S. C. (Univ. of Delhi). Phys. Rev., 174: 1969-76(Oct. 25, 1968).

Double-pion photoproduction is studied with the help of the equal-time commutation relations and the hypothesis of the partially conserved axial-vector current. In the present model both the pions and the photon are dispersed, and hence the pions are treated symmetrically. Further, the study is carried out in the off-mass-shell limit [(pion four-momentum)$^2 \to 0$] in contrast to the soft-pion limits used by earlier authors. Certain difficulties connected with gauge invariance, which arise from this limiting procedure, are noted and discussed; also, the present calculation is expected to be valid only in the low-energy range close to threshold. The results obtained are in good agreement with experiment. (auth)

3669 ELECTROMAGNETIC INTERACTIONS OF LOOSELY-BOUND COMPOSITE SYSTEMS. Brodsky, Stanley J.; Primack, Joel R. (Stanford Univ., Calif.). Phys. Rev., 174: 2071-3 (Oct. 25, 1968).

Contrary to popular assumption, the interaction of a composite system with an external electromagnetic field is not equal to the sum of the individual Foldy–Wouthuysen interactions of the constituents if the constituents have spin. The correct interaction is given, and it is noted that it is consistent with the Drell–Hearn–Gerasimov sum rule and the low-energy theorem for Compton scattering. The validity of additivity of the individual Dirac interactions, and the corrections to this approximation are discussed with particular reference to the atomic Zeeman effect, which is of importance in the fine-structure and Lamb-shift measurements. (auth)

3670 DECAY MODE $\Sigma^0 \to \Lambda^0 + \gamma + \gamma$ AND THE MAGNETIC MOMENT OF THE Σ^0. Mani, H. S.; Yao, York-peng (Univ. of Michigan, Ann Arbor). Phys. Rev., 174: 1797-8(Oct. 25, 1968).

By measuring the branching ratio of $\Sigma^0 \to \Lambda^0 + \gamma + \gamma$ to $\Sigma^0 \to \Lambda^0 + \gamma$, information can be obtained on the magnetic moment of Σ^0 to a considerable accuracy. The low-energy theorem is the basis for the analysis. (auth)

3671 BJORKEN LIMIT AND POLE DOMINANCE. I. THE $\omega\rho\pi$ SYSTEM AND THE ALGEBRA OF FIELDS. Brown, Stanley G.; West, Geoffrey B. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 174: 1777-86(Oct. 25, 1968).

The technique developed in previous work for solving the current-algebra equations for vertex functions in the pole-dominance approximation is modified and simplified. The Bjorken limit is used to incorporate and test assumptions about equal-time commutators (ETC) involving spatial components of currents. Previous results for the $A\rho\pi$ system are shown to be consistent with the ETC derived from the algebra of fields but inconsistent with those of the quark model. It is found that if $g_{\omega\rho\pi} \neq 0$, the ETC of V_i with $D_A(\equiv\partial_\mu A^\mu)$ must not vanish. It is shown, however, that the vanishing of this commutator need not be included in the algebra of fields, since it rests on special assumptions about the form of the symmetry-breaking Lagrangian. In contradistinction to the work of Gell–Mann, Sharp, and Wagner, it is found that the $\omega\rho\pi$ vertex function has a strong off-mass-shell dependence. As a consequence, for example, if strict partial conservation of the axial-vector current is assumed, then π^0 cannot decay into two photons. An explicit vertex function is obtained assuming the algebra of fields and applied to the decays $\pi^0 \to 2\gamma$, $\omega \to \pi\gamma$, $\rho \to \pi\gamma$, and $\omega \to 3\pi$. (auth)

3672 SOFT-PHOTON THEOREM FOR BREMSSTRAHLUNG IN A POTENTIAL MODEL. Heller, Leon (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 174: 1580-7(Oct. 25, 1968).

The bremsstrahlung matrix element calculated from the Schroedinger equation for two particles interacting with each other via a local potential and with the electromagnetic field in the standard gauge-invariant manner is shown to satisfy the soft-photon theorem. That is, the first two terms of the expansion of the radiative matrix element in powers of the photon's energy are calculable from a knowledge of the nonradiative matrix element. The proof is given first without, then with, spin for arbitrary order of perturbation theory in the strong interaction. While the derivation is very different from the one which Low used for a relativistic theory, the final formulas are similar in appearance and agree in the nonrelativistic limit. For low particle momenta, it is found that there is a relation between the on- and off-energy-shell derivatives of the nonradiative T matrix to the leading order in the momentum. Furthermore, the p-wave contribution to the internal-emission matrix element is of the same order in the momentum as the s-wave part. For particle momenta much less than the reciprocal of the s-wave scattering length, the second term of the expansion of the bremsstrahlung matrix element in powers of the photon's energy is negligible compared with the first term. (auth)

3673 ELECTROMAGNETIC PROPERTIES OF BARYONS IN A QUARK–DIQUARK MODEL WITH BROKEN SU(6). Carroll, James; Lichtenberg, D. B. (Tel-Aviv Univ., Israel). Phys. Rev., 174: 1681-8(Oct. 25, 1968).

An investigation of the electromagnetic properties of baryons is made with a quark-diquark model using broken SU(6) wave functions. The magnetic moments are calculated assuming no orbital contributions and equal gyromagnetic ratios for the quarks. The resulting magnetic-moment sum rules deviate slightly from the SU(3) and SU(6) predictions. The electromagnetic mass splittings are assumed to be composed of intrinsic splitting in the quark and diquark, Coulomb terms, and magnetic terms. Fewer sum rules are obtained than with the quark model under analogous assumptions about symmetry breaking. (auth)

3674 CALCULATION OF THE SIXTH-ORDER CONTRIBUTION FROM THE FOURTH-ORDER VACUUM POLARIZATION TO THE DIFFERENCE OF THE ANOMALOUS MAGNETIC MOMENTS OF MUON AND ELECTRON. Lautrup, B. E.; de Rafael, E. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1835-42(Oct. 25, 1968).

The details of a calculation of the sixth-order contribution to $\frac{1}{2}(g_\mu - g_e)$ from the proper fourth-order vacuum polarization are presented. As a by-product of this calculation, the finite part of the fourth-order contribution to the charge-renormalization constant Z_3 was also obtained. (auth)

3675 INTERACTION OF HIGH-ENERGY COSMIC MUONS. Rozental, I. L. Usp. Fiz. Nauk, 94: 91-125(Jan. 1968). (In Russian).

A critical analysis is made of the interaction of high energy muons. Data on accelerator studies of the abnormal interaction of muons are summarized. Theories of the elementary interaction of fast muons are given, and the accuracy of cross section calculations is evaluated. Theories of the passage of fast muons through relatively thick materials are examined. Experimental data on cosmic muons are analyzed. The basic physical conclusions obtained from the study of cosmic muons are reported. An evaluation is made of the upper boundary of the abnormal interaction rapidly increasing with energy. (tr-auth)

3676 ON MAGNETOBREMSSTRAHLUNG (SYNCHROTRON) RADIATION AND ITS REABSORPTION. Ginzburg, V. L.; Sazonov, V. N.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow. Moscow Physical-Technical Inst.). Usp. Fiz. Nauk, 94: 63-90(Jan. 1968). (In Russian).

The magnetobremsstrahlung radiation of individual particles

and of a combination of particles and Cherenkov radiation is examined. The impossibility of distinguishing the energy loss of the emitter in time units is considered. The reabsorption of the magnetobremsstrahlung radiation of ultrarelativistic particles is investigated with consideration given to the changes of both polarization and the radiation intensity. Questions on the measurement of the magnetic field, connected with the magnetobremsstrahlung loss, and on the possibility of the "transfer" of energy from the field to the particles are discussed. (tr-auth)

3677 PROCESSES $e^+e^- \rightarrow 3\gamma$ AT HIGH ENERGIES. Geshkenbein, B. V.; Terent'ev, M. V. (Inst. of Experimental and Theoretical Physics, Moscow). Yadern. Fiz., 8: 550-3(Sept. 1968). (In Russian).

Various spectral and angular distributions for three photons in the process $e^+e^- \rightarrow 3\gamma$ at high energies are obtained. (auth)

3678 VECTOR-DOMINANCE MODEL AND SUM RULES FOR γp INTERACTION AT HIGH ENERGIES. Gerasimov, S. B.; Serdyutskii, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 554-8(Sept. 1968). (In Russian).

In terms of the vector-dominance model for electromagnetic interaction of hadrons the sum rule is obtained connecting the γp interaction cross section with the constant of the photon–vecton meson transition and with the parameters of high-energy meson–nucleon scattering. The constant obtained from the sum rule is compared with the data obtained in various experiments. (auth)

3679 ELECTROMAGNETIC PROPERTIES OF HADRONS IN A PARTIAL SYMMETRY. Enkovski, L.; Kukhtin, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Ukr. Fiz. Zh., 13: 1527-8(Sept. 1968). (In Russian).

In the framework of the Schwinger "partial symmetry" the magnetic moments of baryons and Ω^--hyperon related to the proton magnetic moment are obtained. The probabilities of radiative decays of the type $V \rightarrow P\gamma$ and the constants of magnetic dipole decuplet-octet transitions are calculated. (auth)

3680 PRECISE FORM FACTORS. Green, A. E. S.; Ueda, T. (Univ. of Florida, Gainesville). Phys. Rev. Lett., 21: 1499-1501 (Nov. 18, 1968).

In connection with recent studies of one-boson-exchange potentials the higher order regularized Yukawa functions are related to the nucleon-meson form factor. The adaptation of this form factor to a massless vector-meson field leads to an electromagnetic form factor. The corresponding electrostatic potential follows immediately as a special case. A special example is considered which leads to a very good fit to data. (auth)

3681 FIFTH INTERACTION AND BARYON MASS DIFFERENCES. Buccella, F. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence); Cini, M.; De Maria, M.; Tirozzi, B. Nuovo Cim., 58A: 435-48(Nov. 21, 1968).

The problem of the SU_3-breaking mass splittings and their connection with the electromagnetic ones has been re-examined by using the "fifth interaction" Lagrangian proposed by Ne'eman to interpret the high-energy large-angle proton–proton scattering data, in the framework of the approach suggested by Harari and Segré. Satisfactory results are found for the mass differences and F/D ratio which support the Ne'eman model and provide a justification for the use of a second-order perturbation formula even for the medium-strong interaction. (auth)

3682 EVIDENCE FOR $B-\rho'$ CONSPIRACY FROM PHOTOPRODUCTION SUM RULES. Di Vecchia, P.; Drago, F.; Ferro Fontan, C.; Odorico, R. (International Atomic Energy Agency, Trieste, Italy. International Center for Theoretical Physics, Trieste, Italy). Nuovo Cim., 58A: 531-3(Nov. 21, 1968).

An analysis is presented of the $F_{\frac{1}{2}}^{\frac{3}{2}}$ and $F_{\frac{3}{2}}^{\frac{3}{2}}$ amplitudes in π-photoproduction (to which B and ρ', respectively, can contribute) using continuous moment sum rules. It follows from the analysis that B and ρ' residues satisfy the conspiracy relation at $t = 0$. The contribution of $B-\rho'$ conspiracy to forward π-photoproduction was found to be small. (L.B.S.)

3683 RELATIVISTIC KINEMATICS OF PROCESSES INVOLVING MASSLESS PARTICLES. Goldberg, H. (Tel-Aviv Univ., Israel). Nucl. Phys., B7: 359-74(1968).

Relativistic conditions are deduced and solved for S-matrix elements of two-body decays and quasi-elastic processes involving massless particles. (The method suggested is different—for the quasi-elastic cases—from the ones presented by Zwanziger and Moussa and Stora.) Reduced S-matrix elements are defined. Relations implied by parity and time reversal invariance, as well as in cases of identical particles, are written. The combined effect of unitarity and time-reversal invariance for certain processes is commented on. (auth)

Weak

Refer also to abstract 3683.

3684 (COO–264-444) MODELS FOR K AND η DECAYS. Greenberg, David (Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies. Chicago Univ., Ill. Dept. of Physics). July 1968. Contract AT(11-1)-264. 40p. (EFI–68-60). Dep. CFSTI.

Simple meson pole models for nonleptonic K decays and η decays are presented in the context of current-current Lagrangians for the weak and electromagnetic interactions. Consistency with low energy theorems of current algebra is demonstrated and comparison made with experiment. It is shown that violations of the $\Delta I = 1/2$ rule may be attributed to $\eta-\pi$ mixing. (auth)

3685 BROKEN SYMMETRY MODEL FOR BARYON LEPTONIC DECAYS BASED ON ASYMPTOTIC SYMMETRIES. Divakaran, P. P. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., B7: 459-71(1968).

Superconvergent combinations of weak baryon form factors are constructed from the assumptions that the usually adopted transformation properties of the baryons and the vector and axial-vector currents are exact for matrix elements in the limit of infinite t, and that the direct vector and axial-vector form factors are convergent. The resulting sum rules are saturated with all the known relevant poles. The results are: SU(3) as an asymptotic symmetry predicts that the symmetry breaking (deviation from Cabibbo theory) is unobservable except for a renormalization of the Cabibbo angle to possibly different values θ_V and θ_A. The chiral $SU(3) \otimes SU(3)$ as an asymptotic symmetry allows a calculation of the D/F ratio in axial-vector couplings in terms of the ρ and A_1 masses. It also leads to a correction (due to the A_1) to the pion-pole value of the induced pseudoscalar form factor, and of course gives the Goldberger–Treiman relation. For baryons transforming asymptotically like $[(1,8) \pm (8,1)]$ of the chiral group, all these results are in agreement with observation. (auth)

3686 LIMITS ON HIGH-ENERGY WEAK-INTERACTION CROSS SECTIONS AND THE W-PAIR STRONG-INTERACTION MODEL. Woo, C. H. (Univ. of Maryland, College Park). Phys. Rev. Lett., 21: 1419-20(Nov. 4, 1968).

Deep-mine neutrino experiments set an upper limit of 10^{-33} cm^2 for the reaction cross section of ν_μ-nucleon interaction at 10^3 GeV. The implications of this on the W-pair strong-interaction model are discussed. (auth)

3687 WEAK η PRODUCTION AND THE EXISTENCE OF SECOND-CLASS CURRENTS. Dombey, Norman (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 2127-9(Oct. 25, 1968).

An estimate of the cross section for η production off nucleons by neutrinos is made by assuming that the process takes place via the S_{11} resonance and using the known strong and electromagnetic parameters of the resonance. If second-class weak currents exist, a pion pole contribution would compete with resonance production for this process. (auth)

3688 CURRENT ALGEBRA ON THE MASS SHELL: LEPTONIC K DECAYS. Greenberg, David F. (Univ. of Chicago). Phys. Rev., 174: 1820-8(Oct. 25, 1968).

A method is described by which current-algebra calculations may be done with particles on the mass shell. The method is applied to leptonic K decays. Relations among the current algebra, partially conserved axial-vector current, and dynamical models such as vector-meson dominance are studied in detail. (auth)

3689 STRUCTURE OF THE NONLEPTONIC WEAK INTERACTIONS OF MESONS. Venturi, Giovanni (Rockefeller Univ., New York). Phys. Rev., 174: 2154-64(Oct. 25, 1968).

The limits of validity of an effective weak Hamiltonian involving an intermediate vector boson are studied by examining suitable nonleptonic weak processes. Two extreme assumptions are studied. (1) It is assumed that the dominant contribution to the weak amplitudes is given by the convergent part of the nonleptonic weak matrix elements. Current algebra and spectral-function sum rules are used to evaluate approximately the strong-interaction effects. The approximations involved in such a procedure are discussed and the possibility of parametrizing the diverse nonleptonic matrix elements in terms of a common weak-boson mass is examined. Values of this mass ranging only from 3 to 5 BeV are found, notwithstanding the variety of processes considered. The dependence of the nonleptonic weak matrix element on SU(3) breaking is discussed. (2) The alternative assumption is examined that the divergences in the nonleptonic matrix element are not somehow cancelled, and that they give the leading contribution to the weak amplitudes. In this case it is shown that given certain boundedness conditions on some scattering amplitudes, the nonleptonic matrix elements are quadratically divergent, and the cutoff momentum is independent of strong-interaction effects.

From the diverse weak processes considered we find cutoff momenta ranging from 2 to 5 BeV/c. These results and their implications are discussed. (auth)

3690 POLE MODELS FOR S-WAVE HYPERON DECAY. Carlstone, D. S. (Purdue Univ., Lafayette, Ind.); Rosen, S. P.; Pakvasa, S. Phys. Rev., 174: 1877-81(Oct. 25, 1968).

The K*-pole model and the baryon-pole model are considered as alternatives to the current-algebra calculation of s-wave hyperon decay amplitudes. The conditions under which all three of them yield identical results are clarified. A simple dynamical model, based on the K_1^0 spurion at zero four-momentum, leads to a combination of K*-pole and baryon-pole terms which satisfy these conditions. (auth)

3691 ONCE-SUBTRACTED DISPERSION RELATIONS, CURRENT ALGEBRA, AND K_{l3} FORM FACTORS. Pati, J. C.; Sebastian, K. J. (Univ. of Maryland, College Park). Phys. Rev., 174: 2033-6(Oct. 25, 1968).

K_{l3} decay is treated using once-subtracted dispersion relations, current algebra, and partial conservation of axial-vector current. The dispersion integrals are evaluated by saturating them with the vector K* and scalar κ intermediate states. The subtraction point is chosen so that the subtraction constants may correspond to the soft-pion result. It is shown that if $f_+(t)$ obeys once-subtracted dispersion relations and $f_-(t)$ an unsubtracted one (scheme I), and if $f_K/f_\pi \simeq 1.16-1.28$, then $f_+(0)$ cannot be close to 1 unless a κ meson exists. In this case it is also shown that both λ_+ and λ_- are small, while $\xi = f_-(0)/f_+(0)$ is small and negative. The possibility of having once-subtracted dispersion relations for both $f_+(t)$ and $f_-(t)$ (scheme II) is also considered. It is found that the results of schemes I and II are the same if either (a) there exists a κ meson with mass around 1 BeV and $f_+(0) \simeq 1$, or (b) no κ meson exists, but $f_+(0) \simeq f_K/f_\pi$. If, on the other hand, no κ meson exists, and if $f_+(0) \simeq 1$, while $f_K/f_\pi \simeq 1.28$, then one is able to get λ_- an order of magnitude bigger than λ_+ in scheme II. Thus there is a possibility for large λ_- only in scheme II. Furthermore, in scheme I, using partial conservation of vector current for the strangeness-changing vector current, $(f_K/f_\pi)f_+^{-1}(0) \simeq m_\kappa^2/(m_\kappa^2 - m_K^2)$ is obtained. For $(f_K/f_\pi)f_+^{-1}(0) \simeq 1.28$, $m_\kappa \simeq 1.06$ BeV is predicted. (auth)

3692 W^+-MESON PRODUCTION. Williamson, W. Jr.; Deck, R. T. (Univ. of Toledo). Phys. Rev., 174: 1986-91(Oct. 25, 1968).

The production cross section for weakly interacting W^+ mesons is calculated for the semiweak production process $\gamma + p \rightarrow n + W^+$. The W^+ is assumed to have a magnetic and T-violating electric dipole moment, and the cross section is discussed as a function of these parameters for various possible values of the boson mass. (auth)

3693 METHOD OF CALCULATING THE AXIAL-VECTOR CURRENT COUPLING CONSTANTS FOR LEPTON DECAYS OF BARYONS. Au-Yang, M. K. (Univ. of California, Berkeley). Phys. Rev., 174: 1731-40(Oct. 25, 1968).

Based on the usual assumptions of current algebra and the hypothesis of partially conserved axial-vector current, together with the assumption that the baryon-baryon-meson vertex function vanishes as the four-momentum squared if one of the baryons is "dispersed" to infinity, it is shown that the classic SU(6) and current-algebra results for the axial-vector current coupling constant ($G_A = 5/3$ and $F/D = 2/3$) are the unrenormalized values. The renormalized values are then expressed in terms of the unrenormalized values and certain sidewise dispersion integrals analogous to those introduced by Bincer, Drell, and Pagels. A rough estimate of these integrals give $G_A = 1.22$, which is improved to 1.20 if the experimental pion-nucleon scattering lengths are used in the calculation. The method is general and can be applied to other leptonic decays of baryons. Four of these decays are also considered, and the results agree well with experiment. (auth)

3694 ON SOME NEW PRODUCTION PROCESSES FOR $\approx 10^{12}$ eV MUONS. Murthy, P. V. Ramana (Univ. of Michigan, Ann Arbor). Phys. Lett., 28B: 38-40(Oct. 28, 1968).

Callan and Glashow and Keuffel have proposed the existence of U and W particles respectively, to explain the lack of zenith angular dependence of cosmic ray muons in the experiment by the Utah group. Arguments are presented to show that both these hypotheses are implausible. (auth)

3695 T-ODD SPIN CORRELATIONS IN LEPTONIC DECAYS OF BARYONS. Solov'ev, V. V.; Tsukerman, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 513-23(Sept. 1968). (In Russian).

All the T-odd correlations in leptonic decays of baryons ($B_1 \rightarrow B_2 + l + \nu$) are calculated with the spins of B_1, B_2, and l taken into account assuming the formfactors to be complex. It is shown that all the T-odd correlations of various types depending on the spins of the same two or three particles are related by linear equalities. The possibility to measure the correlations and to compare the experimental data with the calculated results is discussed. The results are compared with the contribution to the T-odd correlations due to the electromagnetic baryon–lepton final-state interaction. (auth)

3696 ON THE Ω^- HYPERON DECAYS. Kopeliovich, V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 524-31(Sept. 1968). (In Russian).

Some effects in leptonic and nonleptonic Ω^- hyperon decays are considered. For the decay $\Omega^- \rightarrow \Xi^0 e^- \nu$, T-odd correlations are calculated which are due to the possibie T violation. The T-odd correlations appearing due to the final state electromagnetic interaction are also calculated. It is shown that the corresponding asymmetries do not exceed 0.05 α if one takes for the Ξ^0 hyperon magnetic moment the value predicted by the SU(3) symmetry. For the Ω^- hyperon nonleptonic decays, a question on the total experiment is discussed, and the expression for the decay probability is obtained depending on the direction of the decay products emission (in the rest system of the Ω^- hyperon), on the polarization of finite hyperon and on the parameters characterising the polarization state of the Ω^- hyperon. (auth)

3697 CONSEQUENCES OF THE γ_5 INVARIANCE FOR THE LEPTON-PAIR DECAYS OF NEUTRAL KAONS. Lipmanov, E. M. (Vologda State Pedagogical Inst., USSR). Yadern. Fiz., 8: 532-4(Sept. 1968). (In Russian).

Based on the momentum conservation and the γ_5 invariance of the neutral lepton current, simple and general qualitative physical conclusions are presented about properties of the elementary particle interactions in the decays $K^0_{S,L} \rightarrow l\bar{l}$. (auth)

3698 ASYMPTOTIC EQUALITY OF NEUTRINO–NUCLEON AND ANTINEUTRINO–NUCLEON INTERACTION CROSS SECTIONS. Nguyen Thi Hong (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 535-6(Sept. 1968). (In Russian).

Asymptotic equality of multiple hadron production cross sections for neutrino–nucleon and antineutrino–nucleon collisions is established. (auth)

3699 ELECTROMAGNETIC RENORMALIZATION OF THE VECTOR PART OF THE $(\nu_e e)(\nu_e e)$ INTERACTION. Folomeshkin, V. N. (Serpukhov Inst. of High-Energy Physics, USSR). Yadern. Fiz., 8: 537-9(Sept. 1968). (In Russian).

The electromagnetic renormalization of the vector part of the $\nu_e + e \rightarrow \nu_e + e$ interaction is considered in the first order weak interaction and account is taken of all the orders in the electromagnetic interaction. It is shown that this renormalization is finite. The numeral value of the renormalization constant Z^W depends on the total hadron contribution to the vacuum polarization. In any case the inequalities $1/2 \leq Z^W \leq 1$ are valid. (auth)

3700 WEAK CHARGED CURRENT AND ΔI ABSOLUTE VALUE = 1/2 RULE IN NONLEPTONIC INTERACTION. Fujii, K. (Hokkaido Univ., Sapporo). Nuovo Cim., 58A: 514-18(Nov. 21, 1968).

The possibility of obtaining the $|\Delta I| = 1/2$ rule in nonleptonic decays on the basis of the current–current picture without introducing neutral currents is investigated. (L.B.S.)

3701 QUARK MODEL, ADDITIVITY, AND THE ALGEBRA OF THE VECTOR CHARGES. Becchi, C.; Eberle, E. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim., 58A: 449-58(Nov. 21, 1968).

The possibility of giving a representation of the algebra of vector charges at any momentum is investigated in the framework of the quark model. Taking into account the additivity property of the quark contributions to the charges, some precise prescriptions are obtained for the charge operators at any momentum. By these prescriptions some relations among the vector-current form factors are given in the case of the Kl_3-decay and of the hyperon leptonic decays. In the case of the Kl_3-decay our relations are the same as those given by D'Espagnat and Gaillard in a recent paper. (auth)

3702 K_{l3} FORM FACTORS AND THE ALGEBRA OF CHARGES. Dahmen, Hans D.; Rothe, Klaus D.; Schuelke, Lothar (Univ., Heidelberg). Nucl. Phys., B7: 472-80(1968).

Starting from the algebra of vector and axial vector charges, information is obtained about the K_{l3} form factors by approximating the commutation relations with the one particle intermediate states. A once subtracted dispersion relation is assumed for the weak form factors appearing in the calculation. The subtraction constants can then be uniquely determined as a function of the weak decay constants f_π, f_K, and f_κ of the mesons contributing in the intermediate states. The momentum transfer dependence of the K_{l3} form factors is characterized by the particle masses, the above mentioned decay constants and the two additional

constants $g_{\pi K K}$ and $f_{K^*} g_{\pi K K^*}$, where $g_{\pi K K}$ and $g_{\pi K K^*}$ are strong coupling constants, and f_{K^*} is the weak decay constant of the K^* meson. Assuming unsubtracted dispersion relations for the various form factors, some numerical predictions are made. (auth)

Strong (General)

Refer also to abstract 3673.

3703 (LAL–1197) REGGE POLES IN HIGH-ENERGY SCATTERING. Lubatti, H. J. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire. Massachusetts Inst. of Tech., Cambridge. Dept. of Physics). 68p. Dep.

Some of the recent results obtained in high-energy interactions of hadrons and the relevance of the Regge-pole model to these data are reviewed. (L.B.S.)

3704 ASYMPTOTIC SUM RULES. Bander, Myron (Univ. of California, Irvine); Bjorken, J. D. Phys. Rev., 174: 1704-8 (Oct. 25, 1968).

New sum rules from current algebra valid in the limit of large negative four-momentum squared of the current are obtained; some of these depend upon commutators of space components of the current densities. They contain convergence factors which make their validity plausible on most models of high-energy behavior, with the Regge-pole model being one of them. With one exception, their utility consists of placing constraints upon models of hadrons designed to saturate the current-algebra scheme. (auth)

3705 SIMPLIFIED DERIVATION OF THE QUARK MODEL PREDICTIONS ABOUT HIGH-ENERGY SCATTERING. Fialkowski, K. (Univ., Krakow); Zalewski, K. Acta Phys. Pol., 34: 521-8(1968).

The quark model is reformulated as a very unorthodox one-particle exchange model. In particular, the quark model predictions for the decay distributions of resonances follow from spin conservation in the vertices. (auth)

3706 REGGE POLES IN PARTICLE PHYSICS. Collins, P. D. B.; Squires, E. J. Springer Tracts in Modern Physics. Volume 45. Berlin, Springer-Verlag, 1968. 297p. DM 78,–; US $19.50.

The S-matrix, partial-wave amplitudes and Regge poles, Regge poles and the Mandelstam representation, spin, the nature of J-plane singularities, bootstraps, perturbation theory and elementary particles, and a survey of the experimental situation are discussed. (W.H.K.)

3707 THEORY OF PARTICLE FUSION BASED ON A FIVE-DIMENSIONAL SCHEME. Bedritskii, A. I. Zh. Eksp. Teor. Fiz., 55: 1367-74(1968). (In Russian).

Equations are set up which are covariant with respect to the five-dimensional homogeneous proper Lorentz group (de-Sitter group for 1 + 4 space) and for the complete and incomplete five-dimensional homogeneous Lorentz groups. A theory of particle fusion is developed on basis of the equations involving a periodic fifth coordinate with a dimension of length and characterizing the rest mass of the particles. In this case the relativistic relation between energy, momentum and rest mass is satisfied. The rest mass can assume unrestricted quantized values. In the authors opinion this circumstance explains the fact itself of appearance of resonance particles and also the discreteness of the energy levels of virtual and bound states of nucleon systems. The particles produced as a result of particle fusion are stable if the initial particles have equal spins and are unstable if the spins are different. States are indicated which differ from those defined by the general Pauli theorem concerning the relation between the spin and sign of the energy and charge density. (auth)

3708 O(4) SYMMETRY AND THE REGGE TRAJECTORY OF THE PION. Frazer, W. R.; Lipinski, H. M.; Snider, D. R. (Univ. of California, San Diego, La Jolla). Phys. Rev., 174: 1932-6 (Oct. 25, 1968).

An off-shell generalization of O(4) symmetry is developed, which is applicable to unequal-mass reactions involving arbitrary spins. The symmetry breaking at $t \neq 0$ is also investigated. These methods are used to analyze the hypothesis that the pion Regge trajectory has the Toller quantum number M = 1 at zero momentum transfer, as seems to be implied by high-energy photoproduction data. It is found that if this hypothesis is correct, then the pion trajectory is necessarily quite complicated. The M = 1 trajectory must mix with another trajectory. The $\bar{N}N\pi$ vertex function then shows a zero near t = 0, in agreement with some fits to high-energy data, but this zero is factorizable. Moreover, a model is exhibited that seems consistent with the hypothesis of partially conserved axial-vector current. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 3843 and 3852.

3709 (AD–671201) DYNAMICAL CALCULATIONS OF PSEUDOSCALAR AND AXIAL VECTOR MESON PARAMETERS USING THE RELATIVISTIC LIPPMANN–SCHWINGER EQUATION. Boguta, J.; Wyld, H. W. Jr. (Illinois Univ., Urbana. Dept. of Physics). June 26, 1968. Contract N00014-67-A-0305. 37p. CFSTI.

A multichannel dynamical calculation of pseudoscalar and axial vector meson parameters is performed using the relativistic Lippmann–Schwinger equation. The channel considered is PV to PV. The potential is computed using the usual Feynman rules and the resulting equations are solved on a computer. The cut-off is fixed by adjusting the output mass of one resonance or bound state or the output width to the experimental value. (auth) (USGRDR)

3710 (DESY–68/47) PROBLEMS IN VECTOR MESON THEORIES. Zimmermann, Wolfhart (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug. 1968. 22p. Dep.

A number of difficulties which occur in any Lagrangian field theory involving vector mesons are discussed. Unfortunately it has not yet been possible to resolve these problems for Yang–Mills fields or charged vector mesons in general. Therefore, the study is restricted to the case of neutral vector mesons in which case one can give a fairly complete analysis of the problems. The model of a massive vector field coupled to a conserved current is considered, and models of two vector fields which are coupled to the same current are described. (auth)

3711 (NYO–2171-250) $\pi\pi$ SCATTERING INFORMATION FROM $\pi N \rightarrow \pi\pi N$. Selove, W. (Pennsylvania Univ., Philadelphia). July 1968. Contract AT(30-1)-2171. 29p. (CONF-680428-13). Dep. CFSTI.

From Conference on Experimental Meson Spectroscopy, Philadelphia, Pa.

Some recent attempts to determine $\pi\pi$ phase shifts from the reaction $\pi^- p \rightarrow \pi\pi N$ are reviewed. (auth)

3712 A PROOF OF THE EXISTENCE OF FUNCTIONS THAT SATISFY EXACTLY BOTH CROSSING AND UNITARITY. I. NEUTRAL PION–PION SCATTERING. NO SUBTRACTIONS. Atkinson, D. (NORDITA, Copenhagen). Nucl. Phys., B7: 375-408(1968).

A fixed-point theorem is used to prove the existence of pion-pion scattering amplitudes that satisfy the Mandelstam representation with full crossing symmetry between the three channels, elastic unitarity between the elastic and inelastic thresholds, and the inelastic unitarity inequalities above the latter. There are no approximations involved, although, in this initial paper, attention is restricted to the case of neutral pion amplitudes and no subtractions. (auth)

3713 PHENOMENOLOGICAL BOUNDS ON THE π-π COUPLING CONSTANT. Shaw, G. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett., 28B: 44-6(Oct. 28, 1968).

Knowledge over any finite energy region of the differential cross section for elastic $\pi\pi$ scattering allows rigorous upper bounds to be put on the $\pi\pi$ coupling parameter λ. These bounds are compared to other estimates. (auth)

3714 SUM RULES INVOLVING THE ρ AND A_1 MESONS AND THE $A_1 \rightarrow \rho + \pi$ DECAY. Matsuda, S. (Univ. of Toronto); Oneda, S. Phys. Rev., 174: 2106-9(Oct. 25, 1968).

Sum rules involving the π, ρ, and A_1 mesons are derived by using a chiral SU(2) ⊗ SU(2) charge-charge density algebra and the hypothesis of partially conserved axial-vector current. The mass-shell extrapolation $m_\pi^2 \rightarrow 0$ is invoked but not $m_\rho^2 \rightarrow 0$. Both the ρ dominance for the pion electromagnetic form factor, $G_{\rho\pi^+\pi^-} G_\rho = \sqrt{2} m_\rho^2$, and the first chiral spectral-function sum rule, $G_\rho^2/m_\rho^2 - G_\lambda^2/m_\lambda^2 = F_\pi^2$, are derived. However, the second one, $G_A = G_\rho$, does not follow without further assumptions. Nevertheless, it is noted that from the above two sum rules, if $\Gamma(\rho) \simeq 130$ MeV, the relation $m_A \simeq \sqrt{2} m_\rho$ leads to $G_A \simeq G_\rho$ or vice versa. The decay $A_1 \rightarrow \rho + \pi$ is discussed. Contrary to the soft-pion calculation, our approach is consistent with having a smaller $\Gamma(A_1 \rightarrow \rho + \pi)$, around 100 MeV. Comparison with the results of other approaches is made. (auth)

3715 RECOIL AND RESCATTERING EFFECTS IN THE STRONG DECAYS OF HIGHER MESONS IN THE QUARK MODEL. Choudhury, D. K. (Univ. of Delhi). Phys. Rev., 174: 2101-5 (Oct. 25, 1968).

Various decay modes of 0^+, 1^+, and 2^+ mesons are investigated in the impulse approximation with contribution from the recoil term. The formalism is then modified to take into account the ef-

fect of scattering of the emitted meson by the other quark (or antiquark) before it finally emerges from the $Q\bar{Q}$ composite. The results for the decay widths obtained in this formalism give better agreement with the experimental values than do the earlier results obtained using only the direct term and ignoring the rescattering effects. (auth)

3716 CHIRAL SYMMETRY FROM DIVERGENCE REQUIREMENTS. Fairlie, D. B.; Yoshida, K. (Univ. of Durham, Eng.). Phys. Rev., 174: 1816-19(Oct. 25, 1968).

The standard nonlinear pion and pion-nucleon Lagrangians which exhibit chiral invariance are derived by imposing conservation of the vector and the axial currents constructed from the fields. It is observed that the pion Lagrangian may be written in the form $-(V^2 + A^2)$, and the standard pion-nucleon Lagrangian is modified, while retaining chiral invariance, in order to admit a similar representation by the addition of 2 four-fermion interactions. Contributions of these additional terms to low-energy s-wave nucleon-nucleon scattering are assessed, and are shown to contribute in the correct experimental proportions to the different channels. Finally, the results of dropping the assumption of bilinearity in the derivatives of the pion fields are discussed. (auth)

3717 MODIFIED PHASE REPRESENTATION AND EFFECTS OF INELASTICITY IN N/D CALCULATION OF p-WAVE PION–PION SCATTERING. Hale, Barbara; Tubis, Arnold (Purdue Univ., Lafayette, Ind.). Phys. Rev., 174: 2074-81(Oct. 25, 1968).

An N/D formalism based on a modified phase representation is used to study the effects of inelasticity on the p-wave pion-pion amplitude. The effects of high-energy inelasticity are introduced in terms of the assumed behavior of the high-energy phase (not phase shift) of the partial-wave amplitude. Using a ρ-exchange input force with the experimental ρ mass and a ρ width of about 100 MeV, and the assumption that the average phase is $\frac{1}{2}\pi$, for total cm energies greater than about $8M_\pi$, it is found that there is no appreciable reduction in the width of the calculated p-wave resonance. The effects of low-energy inelastic channels that may contribute through the inelasticity parameter η for $E \leq E_i$, where E_i is the energy above which the phase assumption is made, are also investigated. None of the forms for η that were used resulted in output width less than about 280 MeV. (auth)

3718 HARD-KAON PROCESSES AND THE SPECTRAL-FUNCTION SUM RULES. Ueda, Yoshiaki (Univ. of Toronto). Phys. Rev., 174: 2082-90(Oct. 25, 1968).

Constructing the Ward-like identities for the currents of chiral SU(3) × SU(3) and expressing these in terms of Weinberg's spectral functions, current-algebra-type calculations are carried out without taking the zero-mass limit. As applications, K_{λ} decay, $K^* \to K + \pi$ decay, $\phi \to K + \bar{K}$ decay, and K_{e3} form factors are discussed and compared with the available experiments. The ϕ decay is calculated without using the conventional ω-ϕ mixing theory. (auth)

3719 BJORKEN LIMIT AND POLE DOMINANCE. II. VIRTUAL $\pi\rho$ SCATTERING. Brown, Stanley G.; West, Geoffrey B. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 174: 1786-93(Oct. 25, 1968).

The Bjorken limit and the pole-dominance approximation (PDA) are applied to a study of four-point functions. $I = 2\pi\rho$ scattering and its off-mass-shell extensions are considered. The four-point function obtained using the PDA and unsubtracted dispersion relations is not consistent with the Bjorken limit, and therefore contact (direct-interaction) terms are added. These terms are determined by use of the Bjorken limit and a smoothness postulate. The π- and A_1-meson intermediate states are first included and the result is used to discuss the π^+-π^0 mass difference for massive pions. The discussion is extended to include ω contributions and some $\pi\rho$ scattering sum rules are examined. (auth)

3720 DYNAMICS AT HIGH SPIN OF THE ρ-A_2 TRAJECTORY. Goldberg, Hyman (Northeastern Univ., Boston). Phys. Rev., 174: 1913-15(Oct. 25, 1968).

It is shown that a high-spin member of the exchange-degenerate ρ-A_2 trajectory can be generated as a bound state of other nearby high-spin members and a d-wave pion. The forces are provided by the exchange of the same heavy mesons. The whole process is self-consistent and becomes spin-independent for high J. A consequence of the model is the local equality of decay widths of these resonances. (auth)

3721 HARD-PION CURRENT-ALGEBRA CALCULATION OF MESON PROCESSES: THREE-POINT FUNCTIONS. Arnowitt, R.; Friedman, M. H.; Nath, P. (Northeastern Univ., Boston). Phys. Rev., 174: 1999-2008(Oct. 25, 1968).

Hard-pion techniques are presented for calculating vertex functions involving π, ρ, A_1, and σ mesons. The development of the method involves the following assumptions: (a) saturation of intermediate sums by single mesons, (b) chiral SU(2) × SU(2) algebra commutation relations, (c) conservation of vector current, and (d) partial conservation of axial-vector current. (auth)

3722 APPLICATION OF HARD-PION THREE-POINT FUNCTIONS. Arnowitt, R.; Friedman, M. H.; Nath, P. (Northeastern Univ., Boston). Phys. Rev., 174: 2008-15(Oct. 25, 1968).

Some comparisons with experiment of the hard-pion three-point functions obtained from SU(2) × SU(2) current algebra are given. Available experimental data involving π, ρ, A_1, and σ mesons are examined. The hard-pion current-algebra method is used to calculate the decays $\rho \to \pi + \pi$, $A_1 \to \pi + \rho$, and $\sigma \to \pi + \pi$, and the electromagnetic form factor of the pion. Peripheral processes such as $\pi + N \to \rho + N$ are also examined as a test of meson-vertex functions for spacelike momentum transfers. Here, to reproduce correctly the momentum-transfer dependence at the nucleon vertex, a new extrapolation for the pionic nucleon form factor is introduced, using the Goldberger–Treiman relation. The results of the above calculations are found to be consistent with the present experimental situation. Current-algebra predictions for the $\gamma + N \to A_1 + N$ cross section and the decays $A_1 \to \pi + \gamma$ and $A_1 \to \pi + \sigma$ are given. A cross section of about 0.1 μb is obtained for the A_1 photoproduction, which is on the verge of being detectable. (auth)

3723 SELF-CONSISTENT CALCULATION OF VECTOR- AND PSEUDOSCALAR-MESON MASS SPLITTINGS. Cohen, S. L. (Univ. of Oregon, Eugene). Phys. Rev., 174: 1867-71 (Oct. 25, 1968).

The medium-strong (MS) mass splittings within the vector- and pseudoscalar-meson octets can be calculated in a completely self-consistent manner. In particular, expressions for the mass splittings may be written down in terms of experimentally observable parameters, one of which, the ρ-π coupling constant $g^2_{\rho\pi\pi}$, is found to be equal to 0.526, in good agreement with the physically observed value 0.60. (auth)

3724 A MODEL FOR S-WAVE PION–PION SCATTERING CONSISTENT WITH RIGOROUS CONSTRAINTS. Auberson, G.; Piguet, O.; Wanders, G. (Univ., Lausanne, Switzerland). Phys. Lett., 28B: 41-3(Oct. 28, 1968).

A model of low-energy S-wave pion-pion scattering is constructed. It fulfills rigorous conditions (resulting from axiomatic field theory) on the nonphysical interval $0 \leq s \leq 4$. It agrees fairly well with our present experimental knowledge and with other theoretical models. (auth)

3725 ANNIHILATION REACTION $p + \bar{p} \to 2\pi^+ + 2\pi^-$ AT HIGH ENERGY AND A MULTI-REGGE MODEL. Ranft, G. (Rutherford Lab., Chilton, Eng.). Nuovo Cim., 58A: 425-34(Nov. 21, 1968).

It is found that the annihilation channel $p + \bar{p} \to 2\pi^+ + 2\pi^-$ can be described by a modified multi-Regge model which takes only nucleon exchange into account. Various one- and two-particle distributions are compared with the experimental data at 5.7 GeV/c. (auth)

3726 UNIFIED FIELD THEORY OF ELEMENTARY PARTICLES. II. TOWARDS A THEORY OF VECTOR-MESONS. van der Merwe, P. du T. (Atomic Energy Board, Pelindaba, South Africa). Nuovo Cim., 58A: 459-67(Nov. 21, 1968).

In the framework of the unified field theory of elementary particles and its concomitant noncanonical quantization procedure, a new binding mechanism is introduced towards a theory of vector mesons as baryon-antibaryon composite states. It is shown that the approach yields realistic vector mesons of real coupling constants. The mass eigenvalue problem is solved in the approximation in which the d-state contribution may be neglected. The theory of the vector meson coupling to its components is presented. (auth)

3727 SPECTRAL-FUNCTION SUM RULES FOR TENSOR CURRENTS. Ademollo, M. (Harvard Univ., Cambridge, Mass.); Longhi, G.; Veneziano, G. Nuovo Cim., 58A: 540-6(Nov. 21, 1968).

It is shown that spectral-function sum rules can be applied with a certain amount of success to the case of antisymmetric tensor currents with C = 1. The sum rules are used to obtain the mass relation $m_B^2 = 2m_\rho^2$. Using the hard-pion technique, the width $\Gamma(B \to \omega\pi)$ and coupling $\rho\omega\pi$ are calculated. (L.B.S.)

3728 SOME CONSEQUENCES OF ASYMPTOTIC SYMMETRY AND POLE DOMINANCE. Fabricius, K. (Univ., Hamburg). Nucl. Phys., B7: 331-5(1968).

Tentative relations between the commutators of time derivatives of vector and axial vector currents that are equivalent to asymptotic symmetry are used to obtain equations between the constants g_ρ, g_A, F_π, m_A^2, $G_{\rho\pi\pi}$. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 3643, 3681, 3686, 3711, 3716, 3722, and 3843.

3729 (LPTHE-TH-68/30) REGGE POLES AND POLARIZATION IN $\bar{K}p$ ELASTIC SCATTERING. Plaut, Guy (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). Sept. 1968. 17p. Dep.

A five Regge pole is presented and used to fit polarization data in K^-p elastic scattering between 2 and 2.4 GeV/c. Following a phenomenological analysis, solutions are obtained consistent with high energy data and sample predictions are given for polarization in other KN scattering experiments. (auth)

3730 SINGLE-PARAMETER FIT TO MESON-NUCLEON FORWARD REACTIONS. Jackson, Jane C. (Arizona State Univ., Tempe). Phys. Rev., 174: 2098-2100(Oct. 25, 1968).

From the formalism combining SU(3) symmetry, exchange degeneracy, and Regge poles, it is found that a single parameter can fit all the existing data in meson-nucleon reactions in the forward direction. (auth)

3731 REGGE PARAMETERS IN CROSSING-EVEN KN SCATTERING. George, David J.; Tubis, Arnold (Purdue Univ., Lafayette, Ind.). Phys. Rev., 174: 1875-6(Oct. 25, 1968).

The method of Olsson is used to estimate the Pomeranchuk P and P′ parameters in KN scattering. Assuming that the forward crossing-even KN amplitude has the asymptotic form, $-\Sigma_{s=P,P'} \gamma_s [e^{-i\frac{1}{2}\pi\alpha_s}/\sin \frac{1}{2}\pi\alpha_s] (\omega/\omega_0)^{\alpha_s}$, where ω is the kaon lab energy and $\omega_0 = 1$ BeV, it is found that a good fit to the dispersion sum rules is given by $\gamma_P = 17.3 \pm 0.1$ mb BeV, $\alpha_P = 1$, $\gamma_{P'} = 7.1 \pm 0.7$ mb BeV, $\alpha_{P'} = 0.89 \pm 0.10$. These parameters give a reasonable fit to the high-energy scattering. (auth)

3732 PION FORM-FACTOR ZERO AND "DIPOLE" NUCLEON STRUCTURE. Brehm, J. J.; Cook, L. F. (Univ. of Massachusetts, Amherst). Phys. Rev., 174: 1901-2(Oct. 25, 1968).

It is suggested that the dipole parametrization of the isovector-nucleon form factor is a consequence of the behavior of the $\pi\pi$ phase shift above the ρ meson. It is conjectured that the phase shift rises through π, and as a result the pion form factor exhibits a zero in the vicinity of 900 MeV. This yields the dipole parametrization without introducing additional parameters. (auth)

3733 ASYMPTOTIC SUM RULES FOR THREE-POINT FUNCTIONS: THE $A_1-\rho-\pi$ SYSTEM. Mathur, V. S. (Univ. of Rochester, New York). Phys. Rev., 174: 1743-8(Oct. 25, 1968).

The A_1-ρ-π system is studied and it is shown that the question of possible subtractions in the dispersion relations for form factors is crucial for understanding the difference between hard- and soft-pion results in the A_1 and ρ decays. A double dispersion representation is suggested for three-point functions. Using a truncation approximation, the Bjorken technique is employed to derive several new sum rules for the spectral functions. Assuming that the sum rules are saturated by low-lying meson states, a study is made to evaluate the constant terms in the dispersion representation of the form factors involved in the $A_1\rho\pi$ and $\rho\pi\pi$ vertices. The case of no subtractions, which formally leads to the soft-pion results, is ruled out on the basis of this investigation, and the well-known hard-pion results for A_1 and ρ decays are rederived. (auth)

3734 INELASTIC EFFECTS IN P_{11}-STATE πN SCATTERING. Ong, Kwok Maw (Univ. of California, Berkeley). Phys. Rev., 174: 1977-86(Oct. 25, 1968).

It is found that the optimal determinantal approximation, as proposed in an earlier paper, leads to accurate solutions for the ND^{-1} equations of πN scattering in the P_{11} state. Both left-hand and right-hand cutoff procedures are used in the formulation of the problem, with similar results. Inelasticity is treated by a method proposed by Froissart. It is shown that a qualitatively correct πN P_{11} phase shift in the low-energy region may be reproduced in a one-channel calculation without Castillejo-Dalitz-Dyson poles, provided that the inelasticity factor is chosen properly. A two-channel model with the (πN^*) as the second channel is discussed, and it is shown that the inelastivity obtained in a rough approximation to the coupled unitarity relations is adequate in generating the "zero" of the P_{11} phase shift. Some implications concerning the nonequivalence of one-channel and multichannel ND^{-1} formalisms are discussed. (auth)

3735 OFF-MASS-SHELL CORRECTIONS TO CURRENT-ALGEBRA CALCULATION OF πN S-WAVE SCATTERING LENGTHS. Levin, David N. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 1759-63(Oct. 25, 1968).

Current-algebra techniques are used to calculate $a^{(+)}$, the even-crossing πN S-wave scattering length. The off-mass-shell extrapolation includes sizable terms ($\sim 0.1 m_\pi^{-1}$) of order q^2 and of all orders in ν. These contributions are found by using a pole model for axial-vector-current-nucleon scattering and on-mass-shell dispersion relations. The experimental result, $a_{exper}^{(+)} = (-0.001 \pm 0.004) m_\pi^{-1}$, is matched if the σ term is vanishing or very small: $\sigma = (0.06 \pm 0.14) m_\pi$. Alternatively, if we take $\sigma = 0$, then the calculation predicts $a^{(+)} = (-0.011 \pm 0.022) m_\pi^{-1}$, which agrees with experiment. In the case of $a^{(-)}$, the off-shell extrapolation is identical to that used in the derivation of the Adler–Weisberger sum rule. The predicted value of $a^{(-)}$ also agrees with experiment. (auth)

3736 RELATIVISTIC THREE-BODY THEORY WITH APPLICATIONS TO $\pi-N$ SCATTERING. Aaron, R. (Northeastern Univ., Boston. Los Alamos Scientific Lab., N. Mex.); Amado, R. D.; Young, J. E. Phys. Rev., 174: 2022-32(Oct. 25, 1968).

Linear relativistic three-body equations for the scattering of a particle from a bound state or correlated pair of the others are constructed by combining the quasiparticle or isobar idea with two- and three-body unitarity as suggested by Blankenbecler and Sugar. After a partial-wave decomposition, the equations turn out to be one-dimensional, and hence are easily solved numerically. Any exchange mechanism and any number of isobars or separable two-body interactions can be included in the equations without violating two- and three-body unitarity and Lorentz invariance. Higher integer-spin separable interactions or isobars are included, in very close analogy to the nonrelativistic case. Applying the equation to the π-N system with pseudoscalar coupling, that is, with only nucleon exchange and no $\pi-\pi$ interaction or $\pi-N^*$ intermediate state, gives a (3,3) resonance but no other interesting structure. That is just what one would expect from such a simple mechanism and encourges us to go on to richer input. Analyzing the answers as a function of nucleon mass shows that the static-model expansion converges very slowly. (auth)

3737 OFF-MASS-SHELL APPROACH TO NUCLEON RESONANCES OF SPIN $\frac{3}{2}$ AND ISOSPIN $\frac{1}{2}$. Sugawara, Masao; Meyer, James W. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 174: 1709-18(Oct. 25, 1968).

The off-mass-shell self-consistency approach studied previously in the case of the strong decays among the nucleon resonances of both spin and isospin $\frac{1}{2}$ is extended to include the nucleon resonances of spin $\frac{3}{2}$ and isospin $\frac{1}{2}$. The off-mass-shell decay amplitudes are defined with respect to the spin-$\frac{3}{2}$ resonance in terms of the field which is a sum of products of the isovector currents and isospinor nucleon field. The above field satisfies the same equal-time commutation relation with the time component of the axial-vector current as does the nucleon field. Four sets of self-consistency conditions are obtained by saturating the unsubtracted and also the once-subtracted dispersion relations satisfied by various off-mass-shell decay amplitudes, in which the subtraction refers to the point where the external pion four-momentum vanishes. It is shown that, in order for a solution to exist that is compatible with all the self-consistency conditions, including the ones obtained previously, at least three spin-$\frac{3}{2}$ resonances have to be assumed, together with at least four spin-$\frac{1}{2}$ resonances including the nucleon itself. However, the solution of the self-consistency conditions in the case of these seven resonances gives some decay amplitudes which are too large in magnitude to be consistent with experiments. It is shown that the addition of the fifth nucleon, which is actually seen in the most recent phase-shift analysis by Lovelace et al., removes this difficulty. Thus, the self-consistency conditions obtained in the present and previous papers need all the nucleon resonances of spin $\frac{1}{2}$ and $\frac{3}{2}$ and isospin $\frac{1}{2}$ that are seen by Lovelace et al. (auth)

3738 CALCULATION OF THE P_{11} πN PHASE SHIFT USING COUPLED πN, σN, AND ϵN CHANNELS. Argyres, Ernestos; Rotsstein, Aaron (McGill Univ., Montreal). Phys. Rev., 174: 1689-94(Oct. 25, 1968).

The matrix ND^{-1} method in the determinantal approximation is applied to the study of the P_{11} πN phase shift using three coupled channels: πN, σN, and ϵN. The ϵ meson (also denoted by S_0) is an S-wave $T = 0$ $\pi\pi$ resonance at a mass of about 730 MeV. Good agreement between the results of the model and experimental data is obtained for both the phase shift δ_{11} and the absorption coefficient η_{11} in the range from threshold to ~600-MeV pion laboratory kinetic energy. (auth)

3739 APPLICATION OF MODIFIED DISPERSION RELATIONS TO THE FORWARD KN CROSSING-EVEN SCATTERING AMPLITUDE. George, David J.; Tubis, Arnold (Purdue Univ., Lafayette, Ind.). Phys. Rev., 174: 1871-74(Oct. 25, 1968).

It has recently been shown that a knowledge of the zeros of a forward elastic scattering amplitude could be used to derive new modified dispersion relations. Using the phase representation, it is shown that the forward crossing-even KN amplitude probably has six zeros in the complex ω (kaon lab energy) plane. Two of

these zeros can be very accurately determined from low-energy scattering data. The modified dispersion relations derived using the knowledge of these zeros yield information on the high-energy parameters, and in general provide a consistency test of the presently available data. The infinite-energy total cross section estimated from a dispersion sum rule is about 15.5 mb, in fair agreement with the experimental total cross section of about 17.3 mb at 20 BeV. (auth)

3740 ISOSPIN AND U-SPIN DEPENDENCE OF HADRON–NUCLEON TOTAL CROSS SECTIONS. Lipkin, Harry J. (Princeton Univ., N. J.). Phys. Rev., 174: 2151-3(Oct. 25, 1968).

The difference $\sigma_{tot}(\pi^-p) - \sigma_{tot}(K^-p)$ is constant within experimental errors from 6 to 20 BeV/c, while other differences, e.g., $\sigma_{tot}(\pi^+p) - \sigma_{tot}(K^+p)$ and $\sigma_{tot}(\pi^-p) - \sigma_{tot}(\pi^+p)$, decrease considerably in this energy range. All present data agree with the quark-model description which places all energy variation and isospin dependence in quark-antiquark amplitudes, while quark-quark amplitudes are constant and isospin-independent. Quark-model predictions relating the isospin dependence of meson-baryon and baryon-baryon cross sections require better data for a significant test. The use of ^3H and ^3He targets for direct measurement of isospin dependence is suggested. Errors are enhanced by taking small differences between direct proton- and indirect neutron-target measurements. The importance of direct measurements of these differences goes beyond the quark model, as similar predictions follow from a Regge picture with finite-energy sum rules. Glauber corrections and consistency tests are discussed. Better measurements are of interest also for U-spin differences, which are an order of magnitude larger than isospin differences and seem to approach finite values at high energies, indicating SU(3) symmetry breaking at asymptotic energies. (auth)

3741 SUM RULES FOR WEAK BBπ AMPLITUDES. Fischbach, E. (State Univ. of New York, Stony Brook); Trabert, K. Contract AT(30-1)-3668B. Phys. Rev., 174: 1843-5(Oct. 25, 1968).

Current algebra and the hypothesis of partially conserved axial-vector current are used to derive sum rules relating nonleptonic $\Delta S = 0$ and $\Delta S = 1$ BBπ amplitudes. It is shown that these sum rules may be used to experimentally distinguish among several recently proposed models for the weak-interaction Hamiltonian density. (auth)

3742 THE DECOUPLET EXCHANGE SUPERCONVERGENCE RELATIONS FOR MESON-BARYON SCATTERING AND CUTS IN THE COMPLEX J-PLANE. Kwiecinski, J. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., 34: 543-6(1968).

The superconvergence relations are studied for that part of the meson-baryon scattering amplitude which corresponds to the decuplet exchange in the t-channel. It is found that only one invariant amplitude satisfies superconvergence relation. This fact is explained in terms of cuts in the complex j-plane. (auth)

3743 ELECTROMAGNETIC EFFECTS IN DISPERSION RELATIONS FOR FORWARD SCATTERING. Solov'ev, L. D.; Shchelkachev, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 540-9(Sept. 1968). (In Russian).

Dispersion relations for the pion–nucleon forward scattering are written with electromagnetic corrections taken into account. The corrections are not to be neglected at comparison of the dispersion relations with the experimental data at high energies. (auth)

3744 AN EMPIRICAL RELATIONSHIP FOR THE MASS OF BARYONS. Schuster, K. (Univ. Jena, Ger.). Acta Phys. Pol., 34: 553-5(1968). (In German).

Of the different quantum numbers the Dirac spin J has apparently the strongest influence on the baryon masses. For a single baryon series, which is characterized by fixed values of the hypercharge Y and the isospin I, a linear relation exists between the mass squared and the spin J. In an attempt to represent the mass squared of the baryons as a function of the quantum numbers J, Y, and I, it is found necessary to distinguish between two classes of baryons. Upon application of a total of six free parameters approximately 30 baryon masses can be determined. (tr-auth)

3745 FINITE ENERGY SUM RULES FOR π-N BACKWARD SCATTERING. Bartl, A.; Widder, F. (Univ., Tuebingen, Ger.). Z. Phys., 217: 321-35(1968).

Finite energy sum rules for the A and B, $\pi - N$ scattering amplitudes are saturated in the region $-0.4\ GeV^2 < u < 0$ with a number of s and t channel resonances. It turns out that a rather large $\pi - \pi$ s wave contribution is needed to get agreement with the high energy Regge pole analysis, which explains the dip structure in π^+p scattering at $u_0 = -0.15\ GeV^2$ by a zero in the N_α contribution. The coupling of the N_α trajectory seems to be much stronger than the coupling of the N_γ and Δ_δ trajectories. (auth)

3746 SU(3) CROSSING RELATION FOR MESON–BARYON SCATTERING AND REGGE POLE THEORY. Iwao, Syurei; Sakai, Sunao (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 40: 550-6(Sept. 1968).

The meson-nucleon scattering data from 6–18 GeV/c were analysed under the hypotheses of the SU(3) crossing relation and the Regge pole theory. The cross sections associated with the unitary singlet trajectory are well explained with the parameters of the Pomeranchuk trajectory in the current analysis. Those associated with the 8_S trajectory show some structure and require the introduction of new octet tensor mesons in addition to known ones. The factorization apparently does not apply to the 8_A associated cross sections and, hence, to the ρ and ω trajectories. The $10 + 10^*$ and 27 plets associated cross sections are zero within experimental error. A physical interpretation of this result is discussed. (auth)

3747 REGGE FERMION POLES AND CROSS SECTION RATIO FOR SCATTERING AT LARGE ANGLES. Rekalo, M. P. (Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 13: 1042-4(June 1968). (In Russian).

The relations between differential scattering cross sections of hadrons at large angles are considered. According to present concepts, the scattering of mesons by nucleons at angles of ~180° in the center-of-mass system is determined at high energies by fermion Regge poles. Present, known baryon resonances can be placed on definite Regge trajectories. The approximation of these trajectories by straight lines with subsequent extrapolation to the region of scattering shows that the main trajectories which determine the asymptotic behavior of scattering amplitudes at large angles are trajectories which correspond to baryons from a decuplet. Data on elastic ($\pi^\pm$ p) scattering at large angles show that in addition to the pole corresponding to the Δ-resonance, it is also necessary to take into account the contribution of Regge poles corresponding to the nucleons. Hence, two limiting cases are considered: (a) the asymptote of the amplitudes is determined by the nucleon Regge poles, and (b) the asymptote of the scattering amplitudes at large angles is determined by the Regge Δ-pole. The relations which hold within the framework of SU(3)-symmetry are used for the interaction constants. It is found that most of the ratios between scattering cross sections at large angles are based only on isotopic invariance, and therefore, these ratios should be readily attained. (TTT)

3748 NEW SUPERCONVERGENT SUM RULES FOR THE PRODUCT OF FACTORIZED AMPLITUDES. Seth, V. P.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cim., 58A: 500-2 (Nov. 21, 1968).

Superconvergent combinations of the products of factorized amplitudes for meson–baryon elastic-scattering processes are constructed, considering the following reactions: $\pi + N \rightarrow \pi + N$, $(\bar{K}\Xi \rightarrow \bar{K}\Xi) + (K\Xi \rightarrow K\Xi)$, $\pi\Xi \rightarrow \pi\Xi$, and $(\bar{K}N \rightarrow \bar{K}N) + (KN \rightarrow KN)$. The sum rules are obtained by saturating these relations with all the particles occurring in the 56 multiplet. (L.B.S.)

3749 REGGE CUTS AND CHARGE-EXCHANGE POLARIZATION. Rivers, R. J.; Saunders, L. M. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 58A: 385-401(Nov. 21, 1968).

The existence of cuts, as well as poles, in the complex angular-momentum plane is demonstrated in two specific models in order to explain the observed polarization in the $\pi^-p \rightarrow \pi^0n$ charge-exchange reaction. The two models, a Reggeized absorption model and a rescattering model based on an approximation to the unitarity equations, predict cuts giving corrections (to the pure Regge ρ-pole amplitudes) of opposite sign and comparable magnitude. This leads to the two models giving different signs for the polarization. The absorption model gives reasonable agreement with experiment, whereas the unitarity model disagrees completely. Actual numerical calculations show at pion laboratory energy $E = 11.2$ GeV that a) in an expansion of the cut amplitudes in powers of $(\ln E)^{-1}$ the first several terms are important, and it is not valid to take the leading terms only and b) both the ρP and $\rho P'$ cuts give important contributions to the polarization. (auth)

3750 QUANTITATIVE HIGH-ENERGY πp SCATTERING PREDICTIONS FROM LOW-ENERGY PHASE SHIFTS. Ferro Fontan, C.; Odorico, R.; Masperi, L. (International Atomic Energy Agency, Trieste, Italy. International Center for Theoretical Physics, Trieste, Italy). Nuovo Cim., 58A: 534-9(Nov. 21, 1968).

Three detailed phase shift analyses of low-energy πN scattering were recently performed by groups at Berkeley, CERN, and Saclay. Continuous moment sum rules are applied to these analysis in order to determine the relevant Regge contributions appearing in the $A^{(-)}$, $B^{(-)}$, $A^{(+)}$, and $B^{(+)}$ amplitudes. The differential cross sections and polarizations of πp charge-exchange and π^+p elastic scattering are predicted up to momentum transfers $t \lesssim 0.3 - 0.4$. The analysis of the CERN phases gives the result that in the $A^{(-)}$

amplitude besides the ρ' a cut is present. The nature of the secondary contribution found to be present in $B^{(-)}$ was not established. Evidence was found for the existence of $B^{(+)}$ of a Regge singularity with $\alpha \sim -0.5, -1$, which contributes negligibly to $A^{1(+)}$. (L.B.S.)

3751 MASS RELATIONS OF BARYONS IN A QUARK MODEL. James, K. R. (Univ. of Manchester, Eng.). Nucl. Phys., B7: 336-44(1968).

SU(3) violation for baryons is discussed on the basis of a simplified quark model with mainly scalar binding. The Λ-Σ splitting of the baryon octet and the SU(6) mass formula for the 56 representation are obtained without two-body SU(3)-breaking interactions. Mass relations are also found for resonances of higher spin, in agreement with available data for the $^5/_2{}^+$ octet and the $^7/_2{}^+$ decuplet. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 3740, 3843, and 4082.

3752 (DESY-68/49) INCLUSION OF THE HIGHER-SPIN ISOBARS IN N-N INTERACTION AND THE COMPLETE STRONG-COUPLING S-WAVE SOLUTIONS WITH A HARD CORE. Wagner, Siegfried (Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (II)). Sept. 1968. 19p. Dep.

The strong coupling potentials derived by Fierz contain the transitions between an infinite set of isobaric two-nucleon states. Except for the non-excited nucleon states, the channels with one or two nucleons in the state N_{33} give an important contribution to the phase shifts; this has been shown previously. The contribution of the higher-spin states is discussed here; only some spin-5/2 isobaric states have an appreciable effect, and all higher isobars may be neglected. The complete strong coupling S-wave solutions are discussed in some detail in comparison with the newest experimental phase shift analysis. The influence of charge-symmetry breaking due to the difference in the neutral and charged pion mass is studied for the S-waves. (auth)

3753 (JINR-P2-4066) STATISTICAL CALCULATION OF INELASTIC COLLISIONS OF FAST PARTICLES WITH THE INTRANUCLEAR NUCLEONS. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 42p. (In Russian). Dep.

It is shown how the angles and the energy, satisfying the laws of energy and momentum conservation and, at the same time, producing the distributions of the given type, can be determined by means of the Monte-Carlo method for every secondary particle, produced in the inelastic collision. Moreover the multiplicity of the particles produced is determined automatically. In the case of the $\pi - N$ interaction this multiplicity is considerably larger than the experimental values obtained at the assumption that the number of π^0-mesons is a half of the number of $\pi^{\pm}$-mesons. The statistical SU_3-symmetry calculations prove the roughness of the latter assumption. The angle-momentum correlations are discussed. For the energy region $T \lesssim 30$ GeV the polynomial approximations of the experimentally obtained integral angular and momentum distributions of the secondary particles for elastic and inelastic $N - N$ and $\pi - N$ collisions have been received. The use of these approximations facilitates considerably the intranuclear cascade calculations. (auth)

3754 (RHEL/R-165) IMPROVED DESCRIPTION OF PARTICLE PRODUCTION BY THE THERMODYNAMIC MODEL. Ranft, J. (Rutherford High Energy Lab., Chilton (England)). June 1968. 13p. Dep. CFSTI. UK 2s. 6d.

A better fit is obtained for the momentum spectra of π^-, K^- and $\bar{p}$, produced in proton-proton collisions according to the thermodynamic model, by including the contribution to the π^--spectra which results from two-body decay of through-going isobars. Preliminary studies also indicated how to change the spectral formulas, within the framework of the model, in such a way as to remove the former disagreement with measurements carried out at 12.5 GeV/c primary protons momentum and small longitudinal secondary momentum. (auth)

3755 (UCID-10169) PRODUCTION OF HEAVY STABLE PARTICLES. Chinowsky, W. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 19, 1965. 11p. Dep. CFSTI.

An estimate is made of the relative yields of nucleon-nucleon reactions with thresholds greater than that obtained in collisions with stationary nucleons $\bar{E}_0$, using the internal Fermi momentum to increase the cm energy of the colliding particles. Typical kinds of reactions considered are those producing the fundamental triplet particles α and β postulated by Lee, Gursey, and Navenberg. For reactions with thresholds $\bar{E}_T < \bar{E}_0$, the principle is invoked that, sufficiently above threshold, all strong interactions proceed with equal rates, to within an order of magnitude. The rates for production of particles with $\bar{E}_T > \bar{E}_0$ are discussed. (L.B.S.)

3756 ESTIMATION OF FOUR-MOMENTUM TRANSFER AND EFFECTIVE MASS IN COHERENT INTERACTIONS OF 200 GeV PIONS WITH EMULSION NUCLEI. Czyzewski, O.; Rybicki, K. (Inst. of Nuclear Research, Krakow). Acta Phys. Pol., 34: 535-8(1968).

Four-momentum transfer and effective mass have been estimated in coherent interactions of 200 GeV pions with emulsion nuclei. The results which are very similar to those at machine energies represent an additional evidence that these are really coherent events. It seems from all data that the cross section for coherent production increases with the increase of primary energy. (auth)

3757 LARGE-ANGLE PROTON-PROTON SCATTERING AND THE POMERANCHUK TRAJECTORY. Huang, Kerson; Pinsky, Stephen (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., 174: 1915-30(Oct. 25, 1968).

Proton-proton scattering at large momentum transfers is analyzed in detail, with spin and the Pauli principle taken into account. It is pointed out that various empirical formulas that fit the gross feature of the data in the neighborhood of 90° c.m. scattering angle are essentially consequences of the Pauli principle. From the data the effective Regge trajectory is determined. Two different trajectories seem to dominate different ranges of momentum transfer, and the switchover from one to the other happens almost discontinuously. The trajectories are consistent with $1 + 0.5t$ and $1 + 0.25t$, respectively. This supports an earlier model proposed by Huang, Jones, and Teplitz, who suggested that the two trajectories correspond to the Pomeranchuk trajectory and a Regge cut generated by it. Assuming this interpretation, some properties of the Pomeranchuk trajectory are deduced. The differential cross section for pp scattering at large momentum transfer is fitted in detail, using this model. Consequences for polarization in pp scattering and the cross sections for $p\bar{p}$ scattering are also discussed. (auth)

3758 WEAK PARTIY-NONCONSERVING POTENTIALS. Tadic, D. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 174: 1694-1703(Oct. 25, 1968).

The weak parity-nonconserving potential due to the exchange of vector borons and pions is calculated for several weak-interaction Lagrangians. Experimental tests using few-nucleon reactions are discussed. Effects in the reaction $n + p \rightarrow d + \gamma$ are estimated in detail. A simple approximate determination of the effective potential for the complex nuclei is included. For reliable information of the weak-interaction Lagrangians, comparison of several processes is needed. (auth)

3759 POTENTIAL MODEL CALCULATION FOR COPLANAR AND NONCOPLANAR PROTON-PROTON BREMSSTRAHLUNG. Drechsel, Dieter (Catholic Univ. of America, Washington, D. C.). Ann. Phys. (N. Y.), 49: 403-44(Oct. 1, 1968).

The cross section for proton–proton bremsstrahlung is calculated for both coplanar and noncoplanar events using the Hamada–Johnston and Reid (soft-core) potentials. Agreement is obtained with the experimental data for angular distributions and cross sections integrated over the photon directions. A detailed analysis is presented of the kinematics, the phase space and the matrix element in the neighborhood of the kinematic limit of noncoplanarity. A rapid decrease of the cross section integrated over photon angles is found as this limit is approached. This is due not to a strong variation of the phase space, which is essentially constant, but to the fact that near the kinematic limit for noncoplanarity of the protons, the photon is restricted to angles for which the probability for emission is small. For low energies ($\lesssim$30 MeV) of the incident proton, analytic expressions are given for the scattering amplitude, valid for coplanar as well as for noncoplanar events. (auth)

3760 D-WAVE EFFECTS IN HIGH-ENERGY PROTON–DEUTERON SCATTERING. Harrington, David R. (State Univ., New Brunswick, N. J.). Phys. Rev. Lett., 21: 1496-8(Nov. 18, 1968).

Effects due to the D-wave component of the deuteron wave function in high-energy proton-deuteron scattering are investigated. Although negligible for most values of momentum transfer, they are quite significant in the dip region where the S-wave single- and double-scattering contributions interfere destructively. Here the D-wave contributions are large enough to fill in the dip, turning it into a shoulder, without the need for phase variation or spin dependence in the nucleon-nucleon amplitudes. (auth)

3761 STUDY OF HYPERFRAGMENTS PRODUCED BY 800 MeV/c K^-. II. FORMATION AND DISINTEGRATION OF

HEAVY HYPERFRAGMENTS. Doporto, M. P.; Senent, F.; Villar, E. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 147-53(May-June 1967).

The results of a Monte Carlo type program on the production of heavy hyperfragments in K^- reactions with heavy nuclei in nuclear emulsions at 800 MeV/c are presented and discussed. Furthermore, the experimental value $F/B = 1.42 \pm 0.05$ obtained for the disintegration products of the hyperfragments suggests that the half-life of Λ in nuclear material is $\sim 10^{-11}$ sec. (tr-auth)

3762 REGGE-POLE FORMALISM FOR PIONIC DISINTEGRATION OF DEUTERON. Lee, Huan (Univ. of California, Berkeley). Phys. Rev., 174: 2130-40(Oct. 25, 1968).

The reaction $\pi^+ + d \rightarrow p + p$ is investigated within the framework of Regge-pole theory. Reggeization of the amplitudes for this process is carried out in detail, and the asymptotic behavior of the helicity amplitudes at zero momentum transfer is discussed. By assuming that the lowest anomalous threshold singularity in the t channel dominates in the nearby region, the nucleon-deuteron Regge residue is calculated in terms of the pion-nucleon Regge residue. The relations to the Regge-pole formalism of various low-energy models used to study this reaction and its inverse are also discussed. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 3656.

3763 (DESY-68/40) MATRIX ELEMENTS OF THE UNITARY REPRESENTATIONS OF THE HOMOGENEOUS LORENTZ GROUP. Joos, H.; Schrader, R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Aug. 1968. 17p. Dep.

In the representation space of the Main Series of SL(2,C) there exists an improper basis, in which the representation of a Cartan Subgroup is diagonal. The matrix elements with respect to this basis can be obtained with the help of differential equations. In this form the connection between the unitary representations and the spinor representations becomes more transparent. (auth)

3764 (ITF-68-63) CHIRAL U(3) x U(3) AND SU(3) x SU(3) DYNAMICS. Sabo, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 24p. (In Russian). Dep.

A number of consequences which can be tested experimentally from the chiral U(3) × U(3) and SU(3) × SU(3) dynamics introduced earlier is obtained. The principle of the "minimum broken symmetries" is formulated and physically grounded in the framework of the dynamics suggested. The experimental consequences from this principle agree with the available experimental data for the strong interactions at the low energies. The electromagnetic interaction is introduced, and it is shown that the predictions of the dynamics introduced agree with the experimental data for the low-energy photoproduction of the pseudoscalar mesons. The dynamics of weak interactions, without considering the break of the strong interaction symmetries, are constructed; they are in qualitative agreement with the available experimental data. (auth)

3765 DYNAMICAL GROUPS AND THE BETHE-SALPETER EQUATION. Kyriakopoulos, E. (Univ. of Chicago). Phys. Rev., 174: 1846-59(Oct. 25, 1968).

A class of equations is considered whose solutions are the n-dimensional spherical harmonics. It is proven that the set of solutions can be accomodated into a single irreducible representation of the Lie algebra $B_{(n+1)/2}$ for n odd, or $D_{(n+2)/2}$ for n even, and also into a single irreducible representation of the group SO(n,2). Examples of such equations are the Schrödinger equation for the H atom as well as its $(n-1)$-dimensional analog, the Schrödinger equation with O(4)-invariant potentials, as well as their $(n-1)$-dimensional analogs; and the Schrödinger equation of an n-dimensional rigid rotator. In the previous $(n-1)$-dimensional cases and in the case of the n-dimensional rotator, the solutions can be accommodated into a single irreducible representation of the algebra $B_{(n+1)/2}$ for n odd, or $D_{(n+2)/2}$ for n even, and the group SO(n,2) is the dynamical group of the equation. In the cases of the H atom and O(4)-symmetric potentials, the algebra D_3 and the group SO(4,2) exist. The class also includes the Bethe-Salpeter (BS) equation for two scalar quarks interacting via the exchange of a scalar boson of zero mass to form a bound state of zero mass, in which case—after the Wick rotation—the algebra B_3 and the dynamical group SO(5,2) exist. When the mass of the bound state is different from zero, the SO(5,2) representation splits into $\Sigma \oplus SO(4,2)$. The BS equation is transformed to an infinite-component wave equation in the case that the mass of the bound state is zero and in the case that the mass is different from zero. In the first case the known eigenvalue spectrum is obtained. In the second case perturbation theory is applied, and the eigenfunctions and eigenvalues to first and second order in perturbation theory, respectively, are given. Finally, in an Appendix, the H atom and the BS equation representations are written in the canonical basis. (auth)

3766 TIMELIKE REFLECTION: THE COUPLING BETWEEN TIME REVERSAL AND THE POINCARE GROUP. Fleming, Gordon N. (Pennsylvania State Univ., University Park). Phys. Rev., 174: 1620-4(Oct. 25, 1968).

Timelike reflection through arbitrary spacelike hyperplanes is discussed as the covariant generalization of time reversal. The von Neumann algebra generated by the set of all timelike reflections is shown to contain the connected segment of the Poincaré group. The equations of motion for the antilinear operators of motion reversal on arbitrary spacelike hyperplanes are derived, and consistency relations between the various hyperplane derivatives of the motion-reversal operators are obtained. (auth)

3767 COUPLING BETWEEN THE POINCARE GROUP AND SPACE-TIME OR SPACELIKE REFLECTIONS ON HYPERPLANES. Miller, James T. Jr.; Fleming, Gordon N. (Pennsylvania State Univ., University Park). Phys. Rev., 174: 1625-30(Oct. 25, 1968).

The notions of space-time inversion and spatial inversion (the parity operation) are generalized to arbitrary spacelike hyperplanes following a similar treatment of time reversal by one of the authors (G.N.F.). It is shown that the translation subgroup can be constructed from the algebra generated by spacetime inversion, and that the entire Poincaré group is contained in the algebra of the spacelike reflections. The conditions under which these results for the passive reflections can be duplicated for the active reflections are determined. (auth)

3768 REPRESENTATIONS OF THE FULL INHOMOGENEOUS LORENTZ GROUP. Yee, D. D. H. (Polytechnic Inst., Brooklyn). Nuovo Cim., 58B: 213-231(Nov. 11, 1968).

The unitary representations of the restricted inhomogeneous Lorentz group derived by Shaw is extended to the full group. It is found that a single irreducible representation admits a Wigner time inversion and by adjoining two irreducible representations with both signs of the energy provides a representation of the full group where both the time inversion and space inversion are represented by antiunitary transformations. The Case-Jehle two-component wave equation for a spin-$\frac{1}{2}$ massive particle is rederived and generalized to arbitrary spin. By considering a direct sum $(m,0) \otimes D^{(s,0)}(\Lambda) \oplus (m,0) \otimes D^{(0,s)}(\Lambda)$ with the same sign of the energy, the representation space admits a Wigner time inversion and a unitary space inversion. By invoking Foldy's condition of strong covariance, it is found necessary to include both signs of the energy resulting in a unitary representation of the full group and a transformation of charge conjugation. The relation of the present work with others is discussed. (auth)

3769 RELATION OF THE CLEBSH-GORDAN COEFFICIENTS OF DIFFERENT SU(n) GROUPS AND SYMMETRIES OF PHYSICAL SYSTEMS. Karasev, V. P.; Shelepin, L. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 615-26(Sept. 1968). (In Russian).

In order to establish relations and to analyze various symmetries of physical systems the theory of the Clebsh-Gordan coefficients (CG coefficients) is proposed. It is shown that any CG coefficients and transformation matrices of the SU(3) group can be constructed from the products of the CG coefficients of the SU(2) group by means of nonstandard summing methods. Possibilities of such a consideration for the other SU(n) groups are shown and corresponding examples are given. By means of $n \times n$ symbols the meaning of nonstandard summing is analyzed and it is shown that the CG coefficient theory of the SU(n) groups can be constructed on the basis of generalized angular momenta theory. Methods to obtain the relation between the CG coefficients and their combinations for various SU(n) groups are considered in detail and possibilities for their application to the analysis of symmetries of physical problems are discussed. (auth)

3770 INTERNAL MANIFOLDS, A DESCRIPTION OF EXACT AND BROKEN SYMMETRIES, INCORPORATING ROTATIONAL EXCITATIONS AS IMPLIED BY THE HYPOTHESIS OF REGGE-RECURRENCES. Minkowski, P. (Univ. of Leuven, Belgium). Helv. Phys. Acta, 41: 1303-44(Dec. 1968).

An attempt is made to introduce the concept of an internal manifold in elementary particle physics, and to realize the simultaneous action of the Poincaré group and of an internal SU 3 symmetry group on this manifold. A restricted class of manifolds

is investigated, Riemannian globally symmetric spaces of type II, on which the internal symmetry group acts through the adjoint representation. The interplay of the two groups supplemented by several auxiliary assumptions determines the manifold uniquely. The abstract manifold and the two Lie transformation groups acting on it are reexamined considering a linear boundary value problem on the manifold, stripped partly of its structure as homogeneous space, to allow the symmetry substitutions of the solutions determine the actions of the two transformation groups. The boundary value problem gives rise to a spectrum of masses depending on spin and internal quantum numbers. Meson and baryon masses are calculated defining special models, in which a continuation to complex angular momenta is carried out. The situation for space like momenta is investigated and the restrictions imposed on the potentials defining the aforementioned models, by demanding that no solutions exist for space like momenta, are studied. The differential equation on the manifold is separable and is reduced to a second order linear differential equation in one dimension. The location of the bound solutions is determined from an associated Jost function. The differential equation is studied by mapping it on an analog potential scattering equation. The analog energy and potential strength appear as algebraic functions of mass, spin, and internal quantum numbers. The breaking of symmetry is treated as a perturbation. Mass splittings within meson and baryon SU 3 multiplets are obtained in first approximation with respect to the strength of the breaking. (auth)

3771 INDUCED REPRESENTATIONS OF INHOMOGENEOUS COMPLETE UNITARY SYMMETRY GROUPS. Gralewski, U.; Westpfahl, K. (Albert-Ludwigs-Univ., Freiburg i. B.). Commun. Math. Phys., 10: 93-113(Oct. 3, 1968). (In German).

By Mackey's method all irreducible unitary representations of those groups are induced which are the semi-direct products of a 2 mn-dimensional real vector group X(mn) and LU(m) ⊗ U(n). These groups can be gained by contraction from the non-compact groups LU(m,n). The representation spaces are explicitely constructed in terms of generalized spherical harmonics. (auth)

3772 A CLASSIFICATION OF THE UNITARY IRREDUCIBLE REPRESENTATIONS OF SU(N,1). Ottoson, Ulf (Inst. of Theoretical Physics, Goteborg). Commun. Math. Phys., 10: 114-31 (1968).

All inequivalent continuous unitary irreducible representations of SU(N,1) ($N \geq 2$) are determined and classified. The matrix elements of the infinitesimal generators realized on a certain Hilbert space are derived. Representations of the groups $\overline{SU(N,1)}$, SU(N,1)/Z_{n+1}, $\overline{U(N,1)}$ and U(N,1) are classified in a similar manner. (auth)

3773 FOURIER ANALYSIS OF THE SU(2,1) GROUP. Hillion, Pierre (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A, 8: 53-79(1968). (In French).

The study of the continuous unitary representations of the SU(2,1) group in the spaces $L^2(X, \mu, \omega)$ where X is the homogeneous space $SU(2,1)/G_0$, G_0 is a closed subgroup, μ is a quasi-invariant measure on X, and ω is an invariant density, furnishes, on the one hand, the principal series, degenerate principal series, and supplementary principal series and, on the other hand, representation, particularly the regular and quasi-regular representations, whose reduction is made by Fourier analysis techniques with respect to the Cartan subgroups, ending in the Plancherel formulas. A possible application to the theory of elementary particles is suggested. (tr-auth)

3774 CLASSIFICATION OF ELEMENTARY PARTICLES INDUCED BY THE HYPOTHESIS OF AN INTERNAL MANIFOLD. Minkowski, P. (Univ., Louvain, Belg.). Nuovo Cim., 58A: 407-24(Nov. 21, 1968).

The classification scheme of multiplets within the framework of an internal manifold describing elementary particles, developed in a previous work is discussed. The relevant functions which reflect the internal structure of the particles are harmonic polynomials on a sphere of dimension 23. The representations of the rotation group in the rest frame of a particle and of the internal symmetry group SU_3 are labelled by an additional quantum number N, the degree of the corresponding harmonic polynomial. The representations for N = 0, 1, 2 are given and candidates for the proposed states discussed. (auth)

3775 INDEX OF REPRESENTATION OF A SIMPLE LIE ALGEBRA. Patera, J. (Univ., Montreal). Nuovo Cim., 58A: 402-6(Nov. 21, 1968).

Two lemmas are proved and other properties recalled to show that an index of representation has all the valuable properties of dimension of representation without being equivalent to it. Unlike the dimension, the index characterizes an irreducible representation up to contragradiency. It is a nontrivial quantity already for the algebra of rank one. An application is suggested. (auth)

3776 CURRENT COMMUTATION RELATIONS IN R(11). Smalley, L. L.; Joseph, D. W. (Univ. of Nebraska, Lincoln). Phys. Rev., 174: 1937-42(Oct. 25, 1968).

An earlier investigation of a class of models similar to SU(6) is extended by the study of Adler–Weisberger-type commutation relations within the framework of the R(11) model. The commutators of the $\Delta S = 0$ and $|\Delta S| = 1$ currents yield $|f_A| \approx 1.5$ and $|f_A| \approx 1.0$, respectively, and $\alpha \equiv (f/d + 1)^{-1} \approx 1.0$, when the baryons are assigned to the simplest representation 32. A sizable mixing with octets in the 320 or some larger representation is required to bring these values into agreement with experiment. It is concluded that SU(6) is unique among models of its type in producing interesting results within a framework of reasonable simplicity. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 3638.

3777 SPLITTING, MIXING, AND SMALL PERTURBATIONS IN SU(3) MULTIPLETS OF VECTOR MESONS. Cook, L. F.; Watson, H. L. (Univ. of Massachusetts, Amherst). Phys. Rev., 174: 2113-26(Oct. 25, 1968).

Various aspects of multiplet mixing are studied within the context of a model with fixed kinematics of broken SU(3) symmetry for the vector mesons. The validity of first-order mass formulas is investigated in terms of a perturbation expansion based on intermultiplet coupling. It is shown that such an expansion is linear within a few percent over extrapolations needed to reach the physical masses. Because of the intermultiplet coupling, the imposition of self-consistency determines the magnitudes of the mass shifts rather than simply the mass ratios. Self-consistency also yields the $\phi - \omega$ mixing angle. Of the two solutions permitted by self-consistency, viz., a symmetric and an asymmetric solution, the symmetric solution is characterized by rapid variation of the intermultiplet coupling. Small perturbations can prevent self-consistency because of this rapid variation, and exclude the symmetric solution, forcing the dynamical system into the disjoint, asymmetrical configuration. It is suggested that these results do not depend on the model in an essential manner and are of a more general character. (auth)

3778 O(3,1) SYMMETRY AND CONSPIRACY IN PHOTOPRODUCTION OF PIONS AT HIGH ENERGY. Nath, L. M. (Purdue Univ., Lafayette, Ind.). Contract 4997-54-3969. Phys. Rev., 174: 1942-7(Oct. 25, 1968).

Photoproduction of pions at high energy and small angles was studied by using the Lorentz group including space reflection and the PCT transformation to project the "crossed partial waves." The dominant contribution to the differential cross section for photoproduction of pions at high energy comes from Toller poles in the complex λ plane with $M = 1$ and $\tau = \pm 1$, where M and λ are the Casimir operators of the group O(3,1) and τ is the signature of the Toller pole. These poles in the complex λ plane were decomposed and classified into different families of Regge poles with alternating signature and parity. The residues of the principal Regge trajectories with $\tau' = 1$, $\sigma' = \pm 1$, where τ' and σ' are, respectively, the signature and parity of the Regge trajectories, were calculated explicitly in terms of the residue of the Toller pole with $M = 1$ and $\tau = 1$. These calculations allow a relation to be derived between the residues of the two conspiring Regge trajectories $\alpha_\pi(t)$ and $\alpha_\pi^{(c)}(t)$ at $t = 0$, which is consistent with the kinematic constraints on the helicity amplitudes in photoproduction of pions along the forward direction. (auth)

3779 PHENOMENOLOGICAL CHIRAL MODEL FOR NON-LEPTONIC HYPERON DECAYS. Schechter, Joseph (Syracuse Univ., N. Y.). Phys. Rev., 174: 1829-31(Oct. 25, 1968).

The S- and P-wave nonleptonic hyperon decay amplitudes are calculated using a chiral-invariant effective Lagrangian. This reproduces the current-algebra results in a very simple way, the baryon pole diagram arising without any ambiguity whatsoever. As is well known, this leaves us with the wrong ratio of S- to P-wave amplitudes. It is noted that one way out of this dilemma is to add another term to the effective Lagrangian which vanishes in the limit of zero pion four-momentum, and hence contributes to the physical answer without contributing to the current-algebra result. The addition of the K* pole diagram leaves us with a rough three-parameter fit to all the amplitudes plus the $K \to 2\pi$ amplitudes. (auth)

3780 CHIRAL DYNAMICS FOR HIGH-SPIN BARYONS AND AN APPLICATION TO DOUBLE-PION PHOTOPRODUCTION. Huang, H. W. (Columbia Univ., New York). Phys. Rev., 174: 1799-1808(Oct. 25, 1968).

An SU(2) × SU(2) chiral-dynamical Lagrangian for baryons of arbitrary spin and isospin is discussed. Cross sections for low-energy double-pion photoproduction from a nucleon are calculated by assuming that the nucleon and one final pion form an isobar Δ(1236 MeV). The results are compared with those obtained by the soft-pion dispersion-relation approach. It is shown that the static-nucleon model gives satisfactory total cross sections but is inadequate for angular-distribution differential cross sections. The theoretical predictions are consistent with experiment. (auth)

3781 T-VIOLATION EFFECTS AND FINAL-STATE INTERACTIONS. Karpman, G. (Institut de Physique Nucleaire, Orsay, France); Leonardi, R.; Strocchi, F. Phys. Rev., 174: 1957-68 (Oct. 25, 1968).

The difficulties connected with tests of time-reversal invariance are analyzed. The experimental situations are discussed in which T-violation effects are a priori forbidden on very general grounds, such as rotational invariance, etc. A rather detailed analysis is given of the effects of final-state interactions, which may in fact simulate T violation. In particular, the case of T-odd correlations in scattering problems is discussed. Prescriptions are given on how to eliminate these spurious effects, or at least how to have them under control. The above techniques are discussed in the case of pion photoproduction in connection with the correlation $\sigma_N \cdot p_N \times k_\gamma$. By suitably applying the above prescriptions, one may completely eliminate final-state-interaction effects and obtain a good test of T violation with no spurious effects. The same general prescriptions are used in discussing T-violation effects in the processes $l + N \rightarrow l' + \Gamma$. (auth)

3782 EXPERIMENTAL STUDY ON TIME-REVERSAL INVARIANCE IN NUCLEAR GAMMA DECAY. Eichler, J. (Inst. fuer Experimentelle Kernphysik, Karlsruhe, Ger.). Nucl. Phys., A120: 535-9(1968).

Time-reversal invariance was studied by measuring $\gamma-\gamma$ coincidences in ^{36}Cl after the capture of polarized thermal neutrons. The contribution of the time non-invariant amplitude for γ-decay to the total amplitude was determined to be $(0.8 \pm 2.3) \cdot 10^{-3}$, thus indicating no violation of T-invariance. (auth)

3783 ASYMPTOTIC SU(3) AND K_{l3} DECAY FORM FACTORS. Srivastava, Prem P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis., 14: No. 2, 85-90(1968).

The hypothesis of the validity of asymptotic SU(3) symmetry for high energies and large momentum transfers is applied to the K_{l3} and π_{l3} decay form factors when some of them may satisfy subtracted dispersion relation. (auth)

3784 RELATION BETWEEN CP VIOLATING PARAMETERS. Chela-Flores, Julian (London Univ.). Nucl. Phys., B7: 409-12(1968).

A simple relation between the parameters of CP violation is derived which turns out to be useful because it is independent of the $\pi-\pi$ phase-shift difference. (auth)

Applications (Strong)

3785 DERIVATION OF INTERMULTIPLET MASS FORMULAS FROM THE CHIRAL SU(3) ⊗ SU(3) CHARGE ALGEBRA. Matsuda, S. (Univ. of Toronto); Oneda, S. Phys. Rev., 174: 1992-8(Oct. 25, 1968).

Intermultiplet mass formulas were derived by using an SU(3) ⊗ SU(3) charge algebra (involving time derivatives) and an approximation [called the SU(3) approximation] previously proposed. The approximation assumes that the SU(3) charge operator V_K [defined, for example, in a quark model, by $V_{K^-} = \int d^3x \bar{q}(x)\gamma_4(\lambda_4 - i\lambda_5)q(x)/2$] acts as an SU(3) generator even in broken symmetry in an appropriately chosen infinite-momentum limit. Besides the Gell-Mann–Okubo mass formulas including first-order mixing, intermultiplet mass formulas were obtained such as (i) $m_{K^{*0}} - m_{\rho^0} = m_{K^{*+}} - m_{\rho^+} = m_{K^{*+}} - m_{\rho^+} = m_{K^{*0}} - m_{A_1}$, (ii) $m_{\rho^-} \simeq m_\omega$, (iii) f-f′ mixing angle $\theta \simeq 30°$ from 2^+ and 0^- mass formulas, and (iv) SU(6)-type decuplet-octet baryon quadratic mass formulas. A brief discussion is presented about the $J^{PC} = 1^{++}$ and 1^+ meson mass formulas. (auth)

3786 POLARIZATION–ASYMMETRY TEST OF TIME-REVERSAL INVARIANCE. Gross, E. E.; Malanify, J. J.; van der Woude, A.; Zucker, A. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 21: 1476-9(Nov. 18, 1968).

Time-reversal invariance for strong interactions, in particular for that part of the force which flips the spin of the proton, has been tested by comparing the polarization and asymmetry in the elastic scattering of 32.9-MeV protons from ^{12}C at 60°. By making the measurements for ^{12}C relative to ^{12}C, where spin flip is forbidden except in case of parity nonconservation, we avoid the need to measure either an absolute beam polarization or absolute analyzing power. Our first result is that the polarization and asymmetry are equal to ±2.5%; consequently, we observe no violation of time-reversal invariance. (auth)

3787 REPRESENTATION FUNCTIONS FOR THE DEGENERATE BARYON SERIES IN U(6) ⊗ U(6). Delbourgo, R. (Imperial Coll. of Science and Tech., London). J. Math. Phys. (N. Y.), 9: 1936-9(Nov. 1968).

The most degenerate class of representation functions $d^{NB}_{W,W'}(\theta)$ pertaining to U(6) ⊗ U(6) have been calculated for arbitrary quark number N with the baryon number B, and W, W′ weights of the $U(6)_W$ subgroup assuming the following values: B = 0, ½, ⅔, 1; [W], [W′] = 1, 6, 21, 56. These functions are the matrix elements of the rotation operator $\exp(-i\theta J_2)$ between basis vectors of the degenerate U(6) ⊗ U(6) Feynman series (characterized entirely by BNW labels), and are essential to the generalized Reggeization program. (auth)

3788 RADIALLY EXCITED MESONS. Freund, P. G. O. (International Atomic Energy Agency, Trieste, Italy. Univ. of Chicago). Nuovo Cim., 58A: 519-23(Nov. 21, 1968).

It was previously suggested that the set of mesons ρ, A_2, R, S, T, V, . . ., exhibits a number of features characteristic of an oscillator-type $q\bar{q}$-spectrum. The possibility of finding mesons corresponding to the radial excitation spectrum of the oscillator is considered from a symmetry point of view. In the oscillator case the relation between different radial excitations is expressed by the rest symmetry group $U_{8q} \times U_{8\bar{q}} \times U_3$ radial. A relativistic formalism is constructed that describes radial U_3 multiplets and their interactions invariant under a properly constructed collinear group U_{3R}. Applications to specific cases of interest are discussed after the straightforward inclusion of $U_6 \times U_6$ symmetry. (L.B.S.)

3789 RELATIVISTIC NON-INVARIANCE SYMMETRIES GENERATED BY LOCAL CURRENTS. Jersak, J.; Stern, J. (Charles Univ., Prague). Nucl. Phys., B7: 413-31(1968).

The possibility of constructing a relativistic spectrum-generating algebraic scheme for hadrons is re-examined, interpreting the symmetry operators in terms of local weak currents. Starting from the quark model an infinite-dimensional Lie algebra containing "light-like" charges and translations P_μ is constructed. Restricting ourselves to the representations labeled by the quantum numbers which may be interpreted physically, the whole scheme is shown to be unambiguously leading to six solutions, defining the masses and weak-coupling constants in terms of Hermitean representations of the algebras SU(3) ⊗ SU(3), SL(3,C) and SU(3) SU(3) ⋉ T_8. (auth)

Field Theories

General

Refer also to abstract 3656.

3790 ON RAINICH'S ALREADY UNIFIED FIELD THEORY. Klotz, A. H. (Univ. of Sydney). Nuovo Cim., 58B: 145-53 (Nov. 11, 1968).

A weak-field-approximation solution of Rainich-Misner-Wheeler field equations is given. It is shown that although the electromagnetic field is fully determined, additional conditions are needed for determination of the gravitational effects. (auth)

3791 CONFORMAL CHANGE IN EINSTEIN'S $^*g^{\lambda\nu}$-UNIFIED FIELD THEORY. I. Chung, Kyung Tae; Song, Man Souk (Yonsei Univ., Seoul). Nuovo Cim., 58B: 201-12(Nov. 11, 1968).

Chung gave the complete set of the general solutions of Einstein's equations in the Einstein's $^*g^{\lambda\nu}$-unified field theory for all classes and all possible indices of inertia. It is investigated how the conformal change enforces the connection and the complete relations between connections in Einstein's $^*g^{\lambda\nu}$-unified field theory are given. These topics will be studied for all classes and all possible indices of inertia. (auth)

Quantum Field Theory

Refer also to abstract 3726.

3792 (IPNO/LA–68/28) PERTURBATION THEORY OF MASSIVE YANG–MILLS FIELDS. Veltman, M. (Utrecht Rijksuniversiteit (Netherlands). Instituut voor Theoretische Fysica. Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). Aug. 1968. 22p. Dep.

Perturbation theory of massive Yang–Mills fields is investigated with the help of the Bell–Treiman transformation. Diagrams containing one closed loop are shown to be convergent if

there are more than four external vector boson lines. The investigation presented does not exclude the possibility that the theory is renormalizable. (auth)

3793 (ITF-68-18) INTEGRAL REPRESENTATIONS OF VACUUM EXPECTATION VALUES WITH ACCOUNT FOR LOCAL COMMUTATIVITY. Gachok, V. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 20p. Dep.

A review is given of the author's works (preprints ITP-67-16, ITP-67-50) dealing with the problem of moments in quantum field theory. The problems of constructing a commutative algebra of operators associated with a given Wightman functional is discussed. The latter can be done in two cases, namely: in the case of the Euclidean quantum theory and in the case for which the condition of positive definiteness is valid in the domain of completely spatially divided vectors. The lecture is supplied with Appendices where the examples are given of the adopted condition of positive definiteness being valid. (auth)

3794 (ITF-68-54) NONLOCAL QUANTUM THEORY OF SCALAR FIELD. II. NONLOCAL INTERACTIONS. Efimov, G. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 59p. (In Russian). Dep.

The axioms of nonlocal quantum field theory are formulated and a few variants of introducing the nonlocality into the theory of S-matrix are suggested. It is proved that the S-matrix of nonlocal theory is unitary in any order of perturbation theory and free from the ultraviolet divergences. (auth)

3795 (ITF-68-60) GENERAL PROPERTIES OF THE TWO-POINT FUNCTION AND INVALIDITY OF THE TCP-THEOREM FOR INFINITE-COMPONENT FIELDS. Todorov, I. T. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 20p. Dep.

A concise review is given of recent work by A. I. Oksak, R. P. Zaikov and the author on general properties of the two-point function, valid for infinite-component fields. A spectral representation of the two-point function is found which takes into account Lorentz invariance and spectrum conditions. It includes a decomposition of the spectral density with respect to spin. The consequences of locality are studied by means of Bogolyubov–Vladimirov's theorem. Examples are constructed showing that locality does not lead automatically to TCP-invariance and that TCP does not imply even weak local (anti-) commutativity in a theory involving infinite-component fields. (auth)

3796 QUANTUM ELECTROMAGNETIC ZERO-POINT ENERGY OF A CONDUCTING SPHERICAL SHELL AND THE CASIMIR MODEL FOR A CHARGED PARTICLE. Boyer, Timothy H. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 1764-76 (Oct. 25, 1968).

The quantum electromagnetic zero-point energy of a conducting spherical shell of radius r has been computed to be $\Delta E(r) \cong 0.09\hbar c/2r$. The physical reasoning is analogous to that used by Casimir to obtain the force between two uncharged conducting parallel plates, a force confirmed experimentally by Sparnaay and van Silfhout. However, while parallel plates are attracted together because of the zero-point energy, a conducting sphere tends to be expanded. Thus although relevant for the understanding of the quantum-mechanical zero-point energy, the result invalidates Casimir's intriguing model for a charged particle as a charged conducting shell with Poincaré stresses provided by the zero-point energy and a unique ratio for $e^2/\hbar c$ independent of the radius. (auth)

3797 SCALAR FIELDS COUPLED TO THE TRACE OF THE ENERGY-MOMENTUM TENSOR. Freund, Peter G. O.; Nambu, Yoichiro (Univ. of Chicago). Phys. Rev., 174: 1741-3(Oct. 25, 1968).

The coupling of a scalar-meson field to the trace of the energy-momentum tensor is formulated in terms of a nonpolynomial interaction Lagrangian. Quantization and applications are discussed. (auth)

3798 RESOLUTION OF THE RUNAWAY PROBLEM FOR THE POLARON. Trubatch, S. L. (California State Coll., Long Beach). Phys. Rev., 174: 1555-8(Oct. 25, 1968).

Runaway modes are shown to result from the standard application of the dipole approximation to the polaron Hamiltonian. These modes do not occur if the Hamiltonian is renormalized before making the approximation. (auth)

3799 QUANTUM ELECTROMAGNETIC ZERO-POINT ENERGY AND RETARDED DISPERSION FORCES. Boyer, Timothy H. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 1631-8(Oct. 25, 1968).

In a manner quite analogous to the demonstration of a connection between nonrelativistic Schrödinger quantum mechanics and classical particle theory in the presence of a random force, it is shown that free-field quantum electrodynamics bears a close resemblance to classical electrodynamics in the presence of a randomly fluctuating transverse field. In particular, the energy eigenvalues and eigenfunctions of the quantum theory are found to be exactly the field energies and probability densities for the stationary probability distributions of randomly fluctuating normal coordinates. The result provides the direct connection between Casimir's zero-point energy calculations and Lifshitz's general theory for retarded dispersion forces between macroscopic objects. As an illustration of the connective, the attractive force between two conducting parallel plates is calculated from a single physical point of view, but by two alternative methods, one running through to Casimir's zero-point energy ideas, and the other following a calculation via the Maxwell stress tensor in analogy with Lifshitz's procedure. (auth)

3800 DISPERSION METHODS IN THE 2V SECTOR OF THE LEE MODEL. Scarfone, Leonard M. (Univ. of Vermont, Burlington). Phys. Rev., 174: 1903-12(Oct. 25, 1968).

The 2V sector of the Lee model is examined from the standpoint of dispersion theory. In this approach, vertices of the type pointed out by Blankenbecler and Cook are used for the purpose of establishing the bound state and eigenvalue condition corresponding to the static interaction of two V particles. Following Amado, the scattering and production amplitudes characteristic of this sector were also determined. In relying on his methods, exact dispersion calculations involving the contraction of a composite particle (the VN bound state) are carried out. The states found in the V and VN sectors are the only intermediate states used throughout. (auth)

3801 QUANTUM FIELD THEORY OF INTERACTING TACHYONS. Dhar, J. (Univ. of Delhi); Sudarshan, E. C. G. Phys. Rev., 174: 1808-15(Oct. 25, 1968).

A quantum field theory of spin-0 particles traveling with speeds greater than that of light has been constructed. The theory constructed here is explicitly Lorentz-invariant; and the quanta of the field obey Bose statistics. Formalism developed for the free field has been extended to the case of interaction of these particles with nucleons. A new feature of theory is the occurrence of negative-energy particles; this is a necessary consequence of the relativistic invariance of the theory, since the distinction between positive and negative energies is not a relativistically invariant concept for such particles. The occurrence of these negative-energy particles does not, however, prevent the theory from being meaningful; the physical interpretation of the situation is provided by the postulate that any process involving negative-energy particles is to be identified with a physical process with only positive-energy particles traveling in the opposite direction, with the roles of emission and absorption interchanged. The scattering amplitudes are the same as in the usual theory with m^2 replaced by $-m^2$. (auth)

3802 COHERENT SOFT-PHOTON STATES AND INFRARED DIVERGENCES. III. ASYMPTOTIC STATES AND REDUCTION FORMULAS. Kibble, T. W. B. (Univ. of Rochester, N. Y.). Phys. Rev., 174: 1882-1901(Oct. 25, 1968).

In paper II of this series, the mass-shell singularities of the Green's functions of quantum electrodynamics were investigated. In this paper, the relationship between these singularities and the asymptotic states of the theory is studied by considering the nature of the intermediate states that can contribute to the corresponding discontinuity functions. The basic principle underlying this work is that the asymptotic states of the theory should not be specified a priori but should be determined from the structure of the Green's function themselves. The pure soft-photon asymptotic states, which can be created from the vacuum by operators constructed from the soft-photon part of the electromagnetic field, are studied first. These states are defined by appropriate weak limits and are shown to span a space with the same structure as in the noninteracting case. Next, states containing a single particle (massive particle or hard photon), together with soft photons, are investigated. These states can appear as intermediate states in the two-point function. They are again defined by weak limits, and are shown to be stable in the absence of external currents. It is demonstrated that the near-mass-shell components of the field operator, acting on the vacuum or on a soft-photon coherent state, yield a state containing one particle and a soft-photon coherent state. Finally, the analysis is extended to two-particle and multiparticle states. The only essentially new feature here is the appearance of factors related to the "Coulomb phases." General reduction formulas are obtained that permit matrix elements between arbitrary asymptotic states to be extracted from the Green's functions. In effect, these matrix elements may be identified with the coefficients not of poles but of branch-point singularities. (auth)

3803 STRUCTURE OF THE LOCAL FIELD THEORY. Gol'fand, Yu. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 600-8(Sept. 1968). (In Russian).

A technique is developed which makes it possible to represent in an observable form the amplitudes of the S-matrix and of other quantities of the theory. It is shown that matrix elements of the S-matrix, of the Heisenberg fields and of their T-product are expressed through various combinations of boundary values of the same analytical function. Unitarity and causality of the field theory are obtained as a direct consequence of the analytical properties of corresponding amplitudes. A general expression for radiation operators is obtained in terms of the T-product of currents of different orders and Lorentz invariant quasilocal terms. (auth)

3804 MANY-CHANNEL DESCRIPTION OF COMPOSITE PARTICLES AND THE CONDITIONS Z = 0. Braun, M. A. (Leningrad State Univ.). Yadern. Fiz., 8: 609-14(Sept. 1968). (In Russian).

A recently proposed method to describe a composite particle by means of an independent field which interacts with other fields with some formfactor under the conditions $Z_1 = 0$ and $Z = 0$, is generalized to the case when several scattering channels are considered simultaneously. All the main results obtained in the single-channel theory also remain in the many-channel case. The conditions $Z_1 = 0$ determine the composite particle mass and the ratios of the coupling constants for different channels. The condition $Z = 0$ determines the values of the coupling constants. A nonlinear bootstrap equation is constructed for the formfactor. (auth)

3805 SCHWINGER TERMS AND THE INTERACTION HAMILTONIAN IN THE QUANTUM ELECTRODYNAMICS. Sokolov, V. V. (Novosibirsk State Univ., USSR). Yadern. Fiz., 8: 559-70(Sept. 1968). (In Russian).

The fact that components of the electromagnetic current density do not commute necessitates a variation of the interaction Hamiltonian in the quantum electrodynamics. The Hamiltonian constructed in the present work contains some terms leading to Feynman graphs with several photon lines in a vertex. These graphs are obtained from the usual ones contracting the fermion propagator lines. Nonvanishing contributions are given only by the graphs that are derived from the divergent primary graphs. Only after these contributions are taken into account, the S matrix became Lorentz- and gauge-invariant in any order of the perturbation theory. The latter is related to the noncovariant structure of the T-product of operators composed from the field operators taken at the same point. In particular, an introduction of a photon-mass counter-term proves to be unnecessary. (auth)

3806 VALIDITY OF QUANTUM ELECTRODYNAMICS AT EXTREMELY SMALL DISTANCES. Alvensleben, H.; Becker, U.; Bertram, William K.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg). Phys. Rev. Lett., 21: 1501-3(Nov. 18, 1968).

We have measured the yield of electron-positron pairs from the reaction $\gamma + C \rightarrow e^+ + e^- + C$ as a test of the validity of quantum electrodynamics at very small distances. Results show that first-order quantum electrodynamics correctly predicts the e^+e^- pair yield up to an invariant pair mass of 900 MeV/c^2. (auth)

3807 ON THE EXISTENCE OF A LOCAL HAMILTONIAN IN THE GALILEAN INVARIANT LEE MODEL. Schrader, R. (Eidgenoessische Technische Hochschule, Zurich). Commun. Math. Phys., 10: 155-78(Oct. 3, 1968).

It is shown that there exists a selfadjoint Hamilton operator in the limit of local coupling for the Galilean invariant Lee Model. The scattering theory of this Hamilton operator in the $V\Theta - N\Theta\Theta$ sector is discussed. (auth)

3808 COMPARISON OF THE FERMI HAMILTONIAN AND YUKAWA HAMILTONIAN. Mandelbrojt, J. (Univ. d'Aix-Marseille, France). Ann. Inst. Henri Poincare, Sect. A, 7: 257-69 (1967). (In French).

A transformation e^{iS} was derived. The transmutations, by this transformation, of the operators of the physical particles of a Fermi theory are partially identifiable with the physical operators of a Yukawa theory. The equation was also found which contains the quantity f^2/ω_λ(ratio of the square of the coupling constant to the energy of the meson) of this Yukawa theory. The physical significance of this partial equivalence is discussed. (J.S.R.)

3809 LOCAL FIELD THEORY AND ISOSPIN INVARIANCE. II. FREE FIELD THEORY OF ARBITRARY SPIN PARTICLES. Carruthers, P. (Univ., Rome. Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N. Y.), 9: 1835-45(Nov. 1968).

The properties of free field theories of arbitrary spin and isospin particles are investigated. Self-conjugate isofermion ($I = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots$) field theories of arbitrary spin S are shown to be nonlocal, with commutators (or anticommutators) failing to vanish outside the light cone. Special attention is given to discrete transformations C, P, and T. For self-conjugate multiplets the parity, charge conjugation, and time-reversal phase factors η_C, η_P, η_T are not arbitrary but obey $\eta_P^2 = (-1)^{2S}$, $\eta_C^2 = (-1)^{2I}\eta_\alpha^2$, $\eta_T^2 = (\eta_\alpha^*)^2$, where the phase $\eta_\alpha = \xi(-1)^{I+\alpha}(|\xi| = 1, \alpha = -I, \ldots, +I)$ arises when the complex-conjugate representations of SU(2) are transformed to the standard basis. Composite products of C, P, and T are discussed, with general phases and attention to the dependence on order of the operators. The six possible CPT operations Θ_i are analyzed. For pair-conjugate multiplets, the operator Θ_i^2 is, in general, a gauge transformation, with phase $(\omega_i^*)^2$ depending on the C, P, T phases and the order in which C, P, and T enter into Θ_i. By postulating that $\Theta_i^2\psi\Theta_i^{-2}$ be independent of the order of C, P, and T, we derive the Yang–Tiomno parity factors ($\pm 1, \pm i$) for pair-conjugate fermions. For self-conjugate multiplets, however, the phase restrictions previously stated lead to a unique order-independent result $\Theta^2\psi\Theta^{-2} = (-1)^{2I+2S}\psi$. The usual local field theory result lacks the factor $(-1)^{2I}$. The latter differs from unity only for the case 2I = odd integer, in which case we are in fact dealing with a nonlocal field theory. The technical details of the theory involve construction of local fields from helicity wavefunctions and helicity particle operators. Fields of spin greater than one are described by the Rarita–Schwinger formalism. An appendix treats in detail the form and properties of the high-spin wavefunctions in the helicity basis. (auth)

3810 CONNECTION BETWEEN SPIN, STATISTICS, AND KINKS. Finkelstein, David (Yeshiva Univ., New York); Rubinstein, Julio. J. Math. Phys. (N. Y.), 9: 1762-79(Nov. 1968).

Sufficiently nonlinear classical fields admit modes called kinks, whose number is strictly conserved in virtue of boundary conditions and continuity of the field as a function of space and time. In a quantum theory of such fields, with canonical commutation (not anticommutation) relations, kinks and their conservation still persist, and even if the intrinsic angular momentum is an integer, a rotating kink can have half-odd angular momentum, if double-valued state functionals are admitted. A natural concept of exchange appropriate for kinks is formulated. The principal result is that for fields with integer-valued intrinsic angular momentum, the observed relation between spin and (exchange) statistics follows from continuity alone, parastatistics being excluded. It is likely that in the theories with even (odd) exchange statistics, suitable creation operators will commute (anticommute). It is shown that, while the rotational spectrum of a kink will in general possess both integer and half-odd spin states, in fields with integer-valued intrinsic angular momentum only one of these two possibilities will ever be observed for each kind of kink, and that there is a nonzero "particle number" (strictly conserved, additive, scalar quantum number) attached to half-odd-spin kinks of each kind. It then follows that a boson and a fermion kink will always differ in at least one particle number, as well as in spin, and that, in particular, every fermion kink will have some nonzero particle number. These results are consistent with the hypothesis that the spinor fields usually employed to describe half-odd-spin quanta are not fundamental, but are useful "point-limit" approximations to operators creating or annihilating excitations in a nonlinear field of particular kinds of kinks in particular internal states. (auth)

3811 ELECTROMAGNETIC PART OF THE FREE YANG–MILLS FIELD. Loos, H. G. (Douglas Advanced Research Labs., Huntington Beach, Calif. Univ. of California, Riverside). Nuovo Cim., 58A: 365-84(Nov. 21, 1968).

The free Yang-Mills field (not restricted to SU_2) carries electric charge and therefore has an electromagnetic part. Two types of identifications of this electromagnetic part are considered: Lie-algebraic identifications and the asymptotic identification. If free Yang-Mills fields falling into parts which do not interact or which interact unilaterally are excluded, the Lie-algebraic identification usually gives a nonvanishing magnetic-charge density. Therefore, this type of electromagnetic identification is dismissed. The asymptotic identification gives an undetectably small magnetic charge and results in the proper electromagnetic long-range interaction in case the holonomy group has rank one. For higher-rank holonomy groups, it remains to be demonstrated that there is only a single electromagnetic-type long-range interaction. Decomposition of the time-space components of the free Yang-Mills field into a covariant transverse and a covariant longitudinal field shows that, under certain broad conditions, Yang-Mills particles need to have a transverse field inside, in order that they can be charged. (auth)

3812 ANALYTIC REGULARIZATION AND GAUGE INVARIANCE. Breitenlohner, P.; Mitter, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Phys., B7: 443-58(1968).

The analytic regularization method proposed by various authors ascribes a finite expression to any Feynman diagram, which contains arbitrary (but finite) constants, if the diagram is diver-

gent without regularization. A formalism is proposed, which allows the incorporation of gauge invariance into this method without changing these results. The connection with subtraction constants of dispersion relations is briefly discussed, and some simple applications in quantum electrodynamics are considered in order to show the use of the method. (auth)

Gravitation and General Relativity

Refer also to abstract 3208.

3813 (ITF-68-52) NONLOCAL QUANTUM THEORY OF SCALAR FIELD. I. LOCAL AND NONLOCAL GENERALIZED FUNCTIONS. Efimov, G. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 68p. (In Russian). Dep.

The space-time properties of the generalized functions of the form $K(x-x') = \Sigma_{n=0}^{\infty} [C_n/(2n)!]\,\Box^n\delta^{(4)}(x-x')$ are studied for various sequences of the coefficients C_n. A practicable role of this class of generalized functions in the construction of the nonlocal quantum field theory is investigated. (auth)

3814 AXIALLY SYMMETRIC ZERO-MASS MESON SOLUTIONS OF EINSTEIN EQUATIONS. Penney, R. (Ford Motor Co., Dearborn, Mich.). Phys. Rev., 174: 1578-9(Oct. 25, 1968).

The field equations for the coupled zero-mass scalar field and gravitational fields are solved in the axially symmetric static case. It is found that the scalar field obeys a flat-space Laplace's equation such that a large class of solutions exists. The spherically symmetric limiting solution is shown to be a simplified version of the solution due to Janis et al. (auth)

3815 COMMENT ON THE ANISOTROPY OF THE PRIMEVAL FIREBALL. Peebles, P. J. E.; Wilkinson, David T. (Princeton Univ., N. J.). Phys. Rev., 174: 2168(Oct. 25, 1968).

An exact theory is presented for the anisotropy of the primeval fireball as a function of our motion through the radiation. (auth)

3816 GLOBAL STRUCTURE OF THE KERR FAMILY OF GRAVITATIONAL FIELDS. Carter, Brandon (Cambridge Univ., Eng.). Phys. Rev., 174: 1559-71(Oct. 25, 1968).

The Kerr family of solutions of the Einstein and Einstein-Maxwell equations is the most general class of solutions known at present which could represent the field of a rotating neutral or electrically charged body in asymptotically flat space. When the charge and specific angular momentum are small compared with the mass, the part of the manifold which is stationary in the strict sense is incomplete at a Killing horizon. Analytically extended manifolds are constructed in order to remove this incompleteness. Some general methods for the analysis of causal behavior are described and applied. It is shown that in all except the spherically symmetric cases there is nontrivial causality violation, i.e., there are closed timelike lines which are not removable by taking a covering space; moreover, when the charge or angular momentum is so large that there are no Killing horizons, this causality violation is of the most flagrant possible kind in that it is possible to connect any event to any other by a future-directed timelike line. Although the symmetries provide only three constants of the motion, a fourth one turns out to be obtainable from the unexpected separability of the Hamilton-Jacobi equation, with the result that the equations, not only of geodesics but also of charged-particle orbits, can be integrated completely in terms of explicit quadratures. This makes it possible to prove that in the extended manifolds all geodesics which do not reach the central ring singularities are complete, and also that those timelike or null geodesics which do reach the singularities are entirely confined to the equator, with the further restriction, in the charged case, that they be null with a certain uniquely determined direction. The physical significance of these results is briefly discussed. (auth)

3817 THEORY FOR THE MEASUREMENT OF THE EARTH'S VELOCITY THROUGH THE 3^0K COSMIC RADIATION. Heer, C. V.; Kohl, R. H. (Ohio State Univ., Columbus). Phys. Rev., 174: 1611-14(Oct. 25, 1968).

The intensity of radiation for an observer moving through thermal radiation is described by an anisotropic temperature $T(\theta) = T(1+\beta\cos\theta)^{-1}$ or $(h\nu^3/c^2)d\Omega d\nu[\exp h\nu/kT(\theta)-1]^{-1}$, where $\beta = v/c$. Temperature-measuring antennas measure $T(\theta)$. Intensity measurements give an anisotropy between radiation along $\pi+\theta$ and θ of $\beta\cos\theta$ for $(h\nu/kT) \ll 1$ (the same as the temperature anisotropy), and $(h\nu/kT)\beta\cos\theta$ for $(h\nu/kT) \gg 1$. Examples of moving detectors and surfaces in the laboratory and in space are discussed. (auth)

3818 EFFECT OF A DEGENERATE NEUTRINO SEA ON ELECTROMAGNETISM. Royer, J. (Stanford Univ., Calif.). Phys. Rev., 174: 1719-24(Oct. 25, 1968).

Modern cosmological theories imply the existence of a universal degenerate Fermi sea of neutrinos. The fact that the Fermi energy K_F varies from theory to theory could, in principle, be used to help decide which universe we live in. It is shown that a parity-violating term is introduced into Maxwell's equations as a result of the neutrino sea. In particular, it is studied whether a new, meaningful limit on the Fermi energy can be established by studying the propagation of light and the character of magnetic fields in such a neutrino sea. Unfortunately, the solutions to these equations show that the effect of the neutrino sea on electromagnetism is too small to be observed. (auth)

3819 ON AN EXTENSION OF ELECTROMAGNETIC AND GRAVITATIONAL TENSORS AND OF THE BEL–ROBINSON TENSORS. Oektem, F. (Middle East Technical Univ., Ankara). Nuovo Cim., 58B: 167-76(Nov. 11, 1968).

In Riemannian space a tensor field $H_{ab\ldots}$ satisfying $\nabla_a H_{bc\ldots} + \nabla_b H_{ca\ldots} + \nabla_c H_{ab\ldots} = 0$ is considered; a generalization of the Maxwell tensor and the Bel-Robinson tensor is obtained. For an Einstein space such a tensor is conservative and one of its contractions reduces to the Bel-Robinson tensor. By means of this generalized Maxwell tensor an expression for gravitational-energy density is found having the form of the classical energy of a rigid body. (auth)

3820 EXPERIMENTS TO DETERMINE THE FORCE OF GRAVITY ON SINGLE ELECTRONS AND POSITRONS. Witteborn, Fred C.; Fairbank, William M. (Stanford Univ., Calif.). Nature (London), 220: 436-40(Nov. 2, 1968).

Two experimental methods are described for measuring the gravitational force on electrons falling through vertical metal tubes. A third method is being devised to study the fall of positrons. (auth)

3821 HAMILTONIAN FORMALISM IN EINSTEINIAN GRAVITATION: GEOMETRICAL ASPECT. Udeschini, Paolo (Univ., Milan). Meccanica, 3: 148-55(Sept. 1968).

In the Hamiltonian formulation of relativistic theory of gravitation the gravitational field at a given time is defined on a space-like hypersurface of Riemannian space-time by six gravitational potentials and as many conjugate momenta. The former characterize the metric of the hypersurface and it is shown that the momenta are constructed tensorially only with the two fundamental tensors of the hypersurface since Dirac's velocities are equated with the components of the second fundamental tensor. Invariants of the two fundamental tensors, geometrically interpretable, can then be introduced into the Hamiltonian. It is at once clear from the Gauss and Codazzi equations, relating the two fundamental tensors of a hypersurface that the four secondary constraints, which the conjugate dynamical variables satisfy, are equivalent to four Einstein gravitational equations. (auth)

3822 LOCAL INTERACTION OF ELECTROMAGNETIC FIELD WITH POLARIZABLE ELASTIC MEDIUM IN THE THEORY OF GRAVITATION. Bennoun, J. F. (Institut Henri Poincare, Paris). Acta Phys. Pol., 34: 469-510(1968). (In French).

An exact classical theory of interaction between the electromagnetic field and the elastic polarizable medium within the gravitational theory, based on an invariance principle, was constructed. This theory solves the open problem of the definition of the classical electromagnetic energy in matter. The equation of the characteristic manifolds of the theory was established with the aim of introducing the study of the classical electromagnetic radiation in matter. The connection with the previous phenomenological models was established for the linear isotropic case. (auth)

3823 INTRODUCTORY RELATIVITY. Rosser, W. G. V. New York, Plenum Press, 1967. 356p.

Newtonian mechanics, the rise of the theory of special relativity, the Lorentz transformations, relativistic kinematics, relativistic mechanics, geometrical representation of Lorentz transformations and the use of 4-vectors, relativistic electromagnetism, the clock paradox, and the theory of general relativity are discussed. (W.H.K.)

3824 CLASSICAL ELECTROMAGNETISM VIA RELATIVITY. AN ALTERNATIVE APPROACH TO MAXWELL'S EQUATIONS. Rosser, W. G. V. New York, Plenum Press, 1968. 301p.

A survey of the theory of special relativity, electromagnetism as a second order effect, the electric and magnetic fields of a point charge moving with uniform velocity, Maxwell's equations via relativity, the vector and scalar potential via relativity, and relativistic electromagnetism are discussed. (W.H.K.)

3825 AXIAL-SYMMETRIC STATIONARY SOLUTIONS OF EINSTEIN FIELD EQUATIONS FOR THE VACUUM. Kramer, D.; Neugebauer, G. (Friedrich-Schiller-Univ., Jena, Ger.). Commun. Math. Phys., 10: 132-9(Oct. 3, 1968). (In German).

For axialsymmetric stationary vacuum fields Einstein equations reduce to a system, derivable from a simple Lagrangian. An investigation of its form invariance leads to a method to construct from known solutions generalized solutions with one additional parameter. The method is applied to Weyl's class and to Kerr metric. (auth)

3826 SPINOR STRUCTURE OF SPACE–TIMES IN GENERAL RELATIVITY. I. Geroch, Robert (Birbeck Coll., London). J. Math. Phys. (N. Y.), 9: 1739–44(Nov. 1968).

In order to define spinor fields on a space–time M, it is necessary first to endow M with some further structure in addition to its Lorentz metric. This is the spinor structure. The definition and the elementary implications of the existence of a spinor structure are discussed. It is proved that a necessary and sufficient condition for a noncompact space–time M to admit a spinor structure is that M have a global field of orthonormal tetrads. (auth)

3827 NONSTATIC ANALOGS OF SCHWARZSCHILD'S INTERIOR SOLUTION IN GENERAL RELATIVITY. Vaidya, P. C. (Gujarat Univ., Ahmedabad, India). Phys. Rev., 174: 1615–20 (Oct. 25, 1968).

A class of nonstatic solutions of Einstein's field equations representing the gravitational field within a spherically symmetric distribution of matter, possessing the property that the four-dimensional stream lines are normal to the hypersurfaces ρ = const, has been developed containing an undetermined function φ of the density ρ of the distribution. This class contains solutions describing contracting as well as expanding distributions with a pressure gradient. In particular, Schwarzschild's interior solution for a homogeneous perfect fluid sphere belongs to this class, when the function φ is chosen as the density ρ itself. If, however, φ is chosen to vary as $\rho^{\frac{1}{2}}$, one gets the Oppenheimer-Snyder-solution for continued gravitational contraction. At the instant when the boundary radius of this distribution takes a stationary value, if the derivative of the function φ is greater than 1 in relativistic units, then the pressure gradient dominates over gravitational attraction and the fluid sphere expands. The situation is reversed if the derivative is less than 1. When the derivative is equal to 1, the stationary boundary becomes static and one gets Schwarzschild's interior solution. (auth)

Scattering Theory

Refer also to abstracts 3656, 3706, 3743, 4055, and 4063.

3828 (IFVE-STF-68-19-K) SCATTERING OF HIGH-ENERGY PARTICLES ON SMOOTH POTENTIALS. Savrin, V. I.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov, Institut Fiziki Vysokikh Energii). 1968. 13p. (In Russian). Dep.

Scattering of high-energy particles on smooth potentials with nonconstant interaction radius has been considered. It is shown that the dependence of the cross-sections follows different laws for different angles. (auth)

3829 (IPNO/LA-68/23) A DERIVATION OF UPPER BOUNDS FOR FORWARD AND FIXED MOMENTUM TRANSFER SCATTERING AMPLITUDES AT HIGH ENERGIES. Chadan, K. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). July 1968. 8p. Dep.

A simple derivation of high energy upper bounds for forward and nearly forward (fixed momentum transfer) scattering amplitudes which satisfy the analyticity properties of axiomatic quantum field theory is given using continuous variables. The case of neutral scalar particles of equal mass is considered. (W.H.K.)

3830 MANY-LEVEL FORMULA FOR SCATTERING FROM EXTREMELY STRONG SQUARE POTENTIALS. Tani, S. (Marquette Univ., Milwaukee). Phys. Rev., 174: 2054–70(Oct. 25, 1968).

A version of the many-level formula for scattering is introduced, considering the potential strength as the fundamental variable. It is applied to extremely strong square potentials. Under such circumstances, a sum over a large number of nonresonant terms is used. The mathematical technique developed here is directly applicable in the discussion of a singular potential scattering. Furthermore, McVoy, Heller, and Bolsterli have pointed out that a deep square well and a high barrier produce similar scattering amplitudes, in spite of the difference in sign. This effect is analyzed in the light of the many-level formula. It is understood in terms of the dominance of the orthogonality effect. It refers to such an effect as is a consequence of the fact that the wave function is orthogonal to any normalizable function introduced within the range of the square potential, which occurs if the potential strength tends to infinity. In the case of attraction, the depth of the square well must be outside the "width of a resonance" in order that this effect may dominate. The relative probability of encountering a resonance with the ratio of the width of a resonance to the distance between two adjacent resonances is defined. It tends to zero as the depth increases without limit. (auth)

3831 KINEMATIC CONSTRAINTS ON HELICITY AMPLITUDES. Stapp, Henry P. (Univ. of California, Berkeley). Phys. Rev., 174: 2091–8(Oct. 25, 1968).

The kinematic constraints on helicity amplitudes are derived directly from basic analyticity properties, without the use of crossing or partial-wave decomposition. The constraints are manifest in a representation of helicity amplitudes used earlier to study their kinematic branch points. That work is completed by extracting from that representation the powers of the kinematic poles. (auth)

3832 EXTENSION OF AXIOMATIC ANALYTICITY PROPERTIES FOR PARTICLES WITH SPIN, AND PROOF OF SUPERCONVERGENCE RELATIONS. Mahoux, Gilbert; Martin, Andre (Univ. of New York, Stony Brook). Phys. Rev., 174: 2140–50 (Oct. 25, 1968).

It is shown that any regularized helicity amplitude that is known from axiomatic local field theory to satisfy dispersion relations for $-t_0 \le t \le 0$ is in fact analytic in the quasi-topological product $|t| < R \times s$ in the cut plane with cuts $s = C + \lambda$, $s = -t - \mu + C'$, where $\lambda, \mu \ge 0$ and R is a fixed number. This is the extension to the scattering of nonzero-spin particles of a result obtained in the scalar case. As a first consequence, the Froissart limits are extended to all helicity amplitudes. Furthermore, it is shown that for $-t_0 \le t \le 0$ and s going to infinity, the regularized helicity amplitudes in the t channel, with initial (final) helicities λ_1 and λ_2 (μ_1 and μ_2), are bounded by $Cs^{1-\max(|\lambda|,|\mu|)}(\ln s)^2$ if $\lambda + \mu$ is even, or by $Cs^{1-\max(|\lambda|,|\mu|)}(\ln s)^3$ if $\lambda + \mu$ is odd, where $\lambda = \lambda_1 - \lambda_2$ and $\mu = \mu_1 - \mu_2$. This gives superconvergent amplitudes as soon as one of the spins is larger than 1. The case of spin-0–spin-1 scattering is marginal, and in the absence of any detailed dynamical information, one cannot obtain a superconvergent amplitude in that case. (auth)

3833 CAUSALITY IN S-MATRIX THEORY. Chandler, Colston (Univ. of New Mexico, Albuquerque). Phys. Rev., 174: 1749–58(Oct. 25, 1968).

Causality conditions referring only to mass-shell quantities are formulated and some consequences are derived. A condition called weak asymptotic causality (WAC) formalizes the requirement that some interaction between initial particles must occur before the last interaction from which final particles emerge. A condition called strong asymptotic causality (SAC) formalizes the requirement that energy momentum should be carried over macroscopic distances only by physical particles. From SAC it follows that all n-particle scattering functions ($n \ge 4$) are analytic, apart from infinitely differentiable singularities, at physical points not lying on any positive-α Landau surface. Moreover, the scattering functions on the two sides of any such Landau surface are analytically connected by a path that passes around the singularity surface in the way prescribed by perturbation theory. Thus, apart from possible infinitely differentiable singularities, the physical-region singularity structure is derived from a mass-shell causality requirement. Several properties of positive-α surfaces are also discussed. (auth)

3834 KINEMATICAL CONSTRAINTS ON HELICITY AMPLITUDES. Mandula, Jeffrey E. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Rev., 174: 1948–56(Oct. 25, 1968).

The kinematical constraints satisfied by helicity amplitudes are derived by two methods. One uses extra kinematical symmetries, which are present whenever there are constraints. The other uses the connection between M functions and helicity amplitudes. It is shown that the threshold and pseudothreshold constraints do not imply conspiracies between different Regge trajectories. The transitions between the different sets of $s = 0$ constraints (which change when masses become equal) are described. (auth)

3835 CALCULATION OF ELASTIC SCATTERING AMPLITUDE BY CONFORMAL MAPPING. Steinbrecher, Gyoergy (Univ. of Craiova, Rumania). Phys. Rev., 174: 1794–6(Oct. 25, 1968).

The problem of computing the scattering amplitude in the spin-zero, equal-mass case by simultaneous use of the unitarity, analyticity, and crossing-symmetry conditions is reduced to the solving of a system of nonlinear algebraic equations by a suitable power-series expansion of the invariant amplitudes. (auth)

3836 ANALYTIC CONTINUATION OF AN AMPLITUDE. Abbe, W. J.; Gary, G. A. (Univ. of Georgia, Athens). Phys. Rev., 174: 2015–21(Oct. 25, 1968).

A general procedure is given for successively continuing the invariant amplitude to arbitrary regions of the z plane when the partial-wave amplitude is given explicitly by the most general modified Cheng representation. The partial-wave expansion is summed in terms of elementary functions or integrals thereof, and no dispersion or background integrals are required. (auth)

3837 DOES LORENTZ-INVARIANCE IMPLY CAUSALITY? Broido, Michael M. (Magdalen Coll., Oxford); Taylor, John G. Phys. Rev., 174: 1606-10(Oct. 25, 1968).

It is investigated whether faster-than-light propagation of particles and wave motion is consistent with Lorentz invariance of the S matrix in the general context of relativistic, off-shell scattering theories. First, it is shown that Lorentz invariance of the Green's functions implies that of certain weight functions; in a field theory, these weight functions are the Wightman functions. Secondly, it is shown that any off-shell scattering theory with Lorentz-invariant Green's functions arises from a field theory with causal equal-time commutators. Thirdly, it is shown that in particle theories with normal connectedness structure, the equal-time commutators are necessarily canonical. These results show that there are great difficulties facing theories of faster-than-light motion which aspire to relativistic invariance. (auth)

3838 OPTIMIZED POLYNOMIAL EXPANSION FOR SCATTERING AMPLITUDES. Cutkosky, R. E.; Deo, B. B. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev., 174: 1859-66(Oct. 25, 1968).

In devising the most efficient way to determine a scattering amplitude from experimental data, it is important to make full use of the analyticity properties of the amplitude. The amplitude f(x) considered here is given by data on a connected part of the real x axis, and f(x) is assumed to be analytic in a simply connected part of the x plane; there are branch cuts on part of the remainder of the real axis. For convenience in practical calculations it is simplest to expand in polynomials, but for greater flexibility one may consider polynomials of some function z(x). The polynomial expansion will converge as rapidly as possible if z(x) maps the domain of analyticity in the x plane onto the interior of a certain ellipse in the z plane. More precisely, the expansion will then have the greatest possible geometric rates of convergence, both to f(x) in the physical region, and also at any arbitrary point away from the physical region to which one may wish to extrapolate. Formulas are given that enable the mapping from a cut plane to an ellipse to be calculated quickly and easily. Some properties of the transformation that are relevant to partial-wave analysis are examined in detail. A method is suggested whereby the requirements of unitarity may be explicitly incorporated. (auth)

3839 CONSTRUCTION OF INVARIANT AMPLITUDES FOR INTERACTIONS OF PARTICLES WITH ANY SPIN. Marinov, M. S. (Inst. for Theoretical and Experimental Physics, Moscow). Ann. Phys. (N. Y.), 49: 357-92(Oct. 1, 1968).

A method to construct phenomenological amplitudes for arbitrary interactions of particles with any spin is presented. The relativistic particle wave functions are taken in the $2 \times (2s + 1)$-component (for spin s) bispinor representation. The vertex functions and the two-body scattering amplitudes are considered in some details. The method is suitable for consideration of the analytical properties, unitarity, the Feynman graphs, the discrete symmetries as well as for the calculation of observable quantities and for the fulfillment of the phase-shift analysis. (auth)

3840 INVERSE PROBLEM IN POTENTIAL SCATTERING THEORY. Loeffel, Jean-Jacques (Inst. for Advanced Study, Princeton, N. J.). Ann. Inst. Henri Poincare, Sect. A, 8: 339-447(1968).

The Schrödinger scattering of a particle of spin 0 by a real, rotationally invariant potential at fixed energy is considered. The following statement, due to Regge is proved: if two such potentials, both belonging to a certain class V described in the text, are known to give rise to partial wave amplitudes having the same Regge interpolation in the complex angular momentum plane, then these two potentials are identical. As a first illustration, a uniqueness result is obtained about Yukawa-like potentials first derived by Martin and Targonski. As a second illustration, it is shown that if two potentials, both belonging to the class V and being of finite range, are known to generate the same scattering amplitude, then these potentials are identical. To conclude, it is shown that one can extract from results of Agranovich and Marchenko a complete characterization of the scattering amplitudes which can be generated by potentials of finite range belonging to the class V. (auth)

3841 S-MATRIX THEORY WITHOUT MOMENTUM. Jacobson, D. A. (Douglas Advanced Research Labs., Huntington Beach, Calif.). Nuovo Cim., 58B: 124-44(Nov. 11, 1968).

The beginnings of a generalized S-matrix theory are established, valid for arbitrary measurements, and therefore not restricted to asymptotic particle momentum measurements. The main nondynamical features of the theory are introduced including unitarity and relativistic invariance, the latter being derived from a postulate which describes the transformation properties of measurements rather than the results of measurements. To illustrate the flexibility of such a generalization, it is shown that, with the aid of one additional, physically motivated postulate, introducing a structure into the class of complete measurements, local current operators can be defined directly in terms of the S-matrix. (auth)

3842 ON THE ASYMPTOTIC BEHAVIOUR OF THE AMPLITUDES OF INELASTIC TWO-BODY PROCESSES. Roizen, I. I. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 571-4 (Sept. 1968). (In Russian).

The dependence of the asymptotic behavior of the amplitudes of binar processes on the unitarity relations in a direct s-channel is considered. It is shown that the most natural is the asymptotic behavior of essentially non-Regge type. This asymptotic behavior can be due to fixed singularity in the l plane only. The energy is estimated starting from where the Regge-type contribution is to become essential. (auth)

3843 VECTOR MESONS AND SCATTERING LENGTHS OF DIFFERENT PROCESSES OF HADRON ELASTIC INTERACTION. Rekalo, M. P. (Ukrainian Physical-Technical Inst., Kharkov). Yadern. Fiz., 8: 575-82(Sept. 1968). (In Russian).

Relations between the lengths of elastic scattering of hadrons in s-state are found assuming the low-energy scattering to be determined by the vector meson exchange. For the processes of elastic πN, NN, KN, ΛN, and ND scatterings the predictions are in good agreement with experimental data. The scattering lengths for elastic $\Lambda\Lambda$, ΣN, and πK scatterings are also calculated. At present the values obtained do not contradict the experimental data from which the scattering lengths are determined with a considerable ambiguity. (auth)

3844 PHYSICAL REGIONS IN INVARIANT VARIABLES FOR FIVE PARTICLES. Nyborg, P. (Agricultural Coll., Vollebekk, Norway). Nuovo Cim., 58B: 247-57(Nov. 11, 1968).

The geometry of the kinematically allowed regions in the space of invariant variables is studied. The various projections of the five-dimensional space are examined using a symmetric description of the various physical processes involving five particles. The results are displayed in a series of figures. (auth)

3845 SOLUTION OF SINGULAR N/D EQUATIONS WITH INELASTIC UNITARITY. Chermalykh, G. N. (Kiev Inst. of Gases). Ukr. Fiz. Zh., 13: 1469-75(Sept. 1968). (In Russian).

On the soluble singular N/D equations with the left-hand absorptive part of the partial-wave amplitude $\mathrm{Im}_L A(\nu) \underset{\nu \to -\infty}{\propto} \lambda$ and the inelasticity coefficient $\eta(\nu) \underset{\nu \to \infty}{\to} 0$ (ν is square of the c.m. momentum) it is demonstrated that whenever $\mathrm{Im}_L A(-\nu) \neq \mathrm{Im}_p A(\nu)$ ($= [\eta(\nu) \cos 2\delta(\nu) - 1]/2_\rho(\nu)$) at $\nu \to +\infty$ (even when the leading terms in the asymptotics are equal but the consequent terms are not equal) an infinite number of ghosts arises in $A = N/D$ far to the left with an accumulation point at $\nu = -\infty$ and $\delta(\nu) \to \infty$. In the plane of the coupling constant the branch point appears at the value corresponding to $\lambda = 1/2$ at which the equality $\mathrm{Im}_L A(-\nu) = \mathrm{IM}_p A(\nu)$ ($\nu \to \infty$) begins to be broken. (auth)

3846 APPROACH TO THE THREE-BODY SCATTERING PROBLEM. Jasperse, J. R. (Office of Aerospace Research, Bedford, Mass.). J. Math. Phys. (N. Y.), 9: 1931-6(Nov. 1968).

Some new equations for the wavefunction for the three-body scattering problem are derived using the "partial-wavefunction approach." All scattering processes are solutions of inhomogeneous coupled integral equations for the scattered parts of the total wavefunction. It is shown how the Pauli principle is incorporated when some or all of the particles are identical. This leads to a reduction in the number of independent scattered partial wavefunctions when some of the particles are identical. The kernels in the integral equations contain no δ functions but each scattered partial wavefunction does have a self-coupling term. The method is applied to the scattering of three identical bosons interacting through zero-range pair potentials. The method gives the same equation for this problem as obtained by the Faddeev T-matrix approach. (auth)

3847 DERIVATION OF NONRELATIVISTIC SUM RULES FROM THE CAUSALITY CONDITION OF WIGNER AND VAN KAMPEN. Chadan, K.; Montes, A. (Laboratoire de Physique

Theorique et Hautes Energies, Orsay, France). J. Math. Phys. (N. Y.), 9: 1898-1914(Nov. 1968).

Nonrelativistic sum rules previously obtained for each phase shift in the framework of elastic scattering by a local central potential of finite radius are shown to follow from the causality principle of Wigner and Van Kampen, under the assumptions that the phase shift satisfies the Levinson theorem and that, at high energies, the integrability condition holds. In fact, it is shown that under these assumptions, any interaction of finite radius which is causal in the sense of Wigner and Van Kampen is equivalent to a local potential of the same radius. First the sum rules and some of their applications are reviewed. A brief survey is given of their proof in potential scattering, which is based essentially on the analytic and asymptotic properties of the Jost function (or the S matrix). Then it is shown that, under the assumptions mentioned above on the phase shifts, the properties of the R matrix derived by Wigner and Van Kampen from causality lead to the same analytic and asymptotic properties of the Jost function (defined now directly from the S matrix) as in potential scattering, providing, therefore, sufficient information for the direct derivation of the sum rules. Finally, using the Gel'fand–Levitan and Marchenko integral equations of the inverse-scattering problem, it is shown that, in fact, this information is sufficient to entail that the causal interaction of Wigner and Van Kampen is equivalent to a local potential of the same radius. (auth)

3848 KINEMATIC SINGULARITIES OF HELICITY AND TRANSVERSITY AMPLITUDES AND ASYMPTOTIC REGGE-POLE CONTRIBUTIONS. McKerrell, A. (Univ. of Cambridge, Eng.). J. Math. Phys. (N. Y.), 9: 1824-32(Nov. 1968).

The crossing relation for transversity amplitudes is used in a simple proof of the kinematic-singularity structure of helicity amplitudes, both in the general-mass and in various particular-mass cases. A comparison with earlier results is made. The kinematic properties of helicity and transversity amplitudes are employed in the derivation of an asymptotic expression for the contribution of Regge poles to the amplitude. (auth)

3849 VARIATIONAL APPROACH TO MULTIPLE SCATTERING. Levine, A. D.; Hayes, C. F. (West Virginia Univ., Morgantown). J. Math. Phys. (N. Y.), 9: 1845-7(Nov. 1968).

Using a variation technique, two coupled equations are derived whose transition matrix is shown to describe multiple scattering. The resulting index-of-refraction equation differs from that obtained in previous theories by our inclusion of the effect of the scatterer on the target and certain constants of approximation. (auth)

3850 NARROW RESONANCE SATURATION OF SUM RULES: A NONUNIQUENESS THEOREM. Atkinson, D. (Univ., Rome). J. Math. Phys. (N. Y.), 9: 1848-64(Nov. 1968).

It is shown that, if the superconvergence relations appertaining to a two-particle scattering process are saturated by an infinite tower of resonances of mass m_J, where J is the spin, then m_J must increase less quickly than J in all cases. With this observation, it is shown that the complex of all the superconvergence relations for all the processes $a(J_1) + a(J_2) \rightarrow a(J_3) + a(J_4)$, where a(J) is the spin-J member of the same tower of particles, possesses an infinity of solutions for the coupling constants. It is concluded that the superconvergence relations are incomplete, and need to be supplemented by some new physical principle, if they are to be of any practical use. A possible exception to this rule is when all but a finite number of residues are constrained to be positive, with no negative coefficient from the isospin crossing matrices. In this case, a given solution may be unique if m_J increases not more quickly than $J^{\frac{1}{2}}$. (auth)

3851 STRONG-COUPLING LIMIT IN POTENTIAL THEORY. II. Frank, William M. (Bar-Ilan Univ., Ramat Gan, Israel). J. Math. Phys. (N. Y.), 9: 1890-8(Nov. 1968).

The analytic properties of the Jost function in the coupling constant g, derived in an earlier article for a restricted class of potentials, are rederived generally for potentials V(r), for which $|V(r)|$ can be bounded by a monotonically decreasing potential $\nabla(r)$, such that $\int dr|\nabla(r)|^{\frac{1}{2}} < \infty$. In particular, potentials with nonlinear exponential tails are studied as a function of the energy and coupling constant. Earlier results of Sartori on the energy dependence of the Jost function, derived only for special cases of such potentials in the Born approximation, are demonstrated to be true generally for large classes of such potentials. (auth)

3852 POSSIBLE APPLICATION OF NEWTON-KANTOROVICH'S METHOD TO LOW-ENERGY $\pi\pi$ SCATTERING. Amatuni, A. Ts. (CERN, Geneva). Nuovo Cim., 58A: 321-39(Nov. 21, 1968).

A possible method for obtaining approximate solutions of low-energy $\pi\pi$ scattering partial-wave equations is considered. It is based on a modification of Newton's method which was developed by Kantorovich in application to nonlinear functional equations, and which reduces the whole problem, in the presented case, to the solutions of algebraic (nonlinear) equations. (auth)

3853 INELASTIC UNITARITY AND J-PLANE SINGULARITIES IN A GENERAL PROCESS. Bassetto, A.; Paccanoni, F. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cim., 58A: 313-20(Nov. 21, 1968).

The Gribov-Pomeranchuk singularities are studied for a coupled-channel process where the external particles have different masses and spins. It is shown how the presence in the amplitude of fixed poles in the angular-momentum plane at wrong-signature nonsense points can be spontaneously reconciled with the unitarity condition, provided that the inelastic contributions are suitably modified by moving cuts (Mandelstam cuts). Some properties of these cuts are examined first on a general basis and then, in more detail, in a particular model. (auth)

3854 RELATIVISTIC TWO-PARTICLE SCATTERING. Schierholz, G. (Univ., Hamburg). Nucl. Phys., B7: 432-42 (1968).

A complete theory of relativistic two-particle scattering is given. Generalized Møller operators are constructed within the framework of time-independent scattering theory. Their existence is proved under certain asymptotic conditions, which turn out to be minimal and consistent. In addition singular integral equations for the T-matrix are derived. They are reduced to a Fredholm form and it is shown that both integral equations are equivalent. (auth)

Particle Accelerators

Refer also to abstracts 2709, 3169, 3656, and 3676.

3855 (AE-333) APPLICATION OF A BETATRON IN PHOTONUCLEAR ACTIVATION ANALYSIS. Brune, D.; Mattsson, S.; Liden, K. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Aug. 1968. 13p. Dep.

The present study concerns the determination of fluorine, iodine, lead and mercury by means of photonuclear activation technique using a betatron. The detection limit obtained for the elements in the above given sequence amounted to 3, 50, 400 and 15 μg respectively. The technique was applied in the determination of iodine in pharmaceuticals. A rotating sample holder device was inserted in the bremsstrahlung beam of the betatron in order to ensure uniform irradiation of the samples. (auth)

3856 (AEC-tr-6949) 1000-GeV CYBERNETIC PROTON ACCELERATOR. Vasil'ev, A. A. (ed.). Translation of Kiberneticheskii Uskoritel' Protonov na Energiyu 1000 GeV, Radiotekhnicheskii Institut, Akademiya Nauk SSSR, Moscow, 1967. 349p. Dep. CFSTI.

An abstract was previously prepared from the original language and appears in NSA as 22: 18067. (B.G.D.)

3857 (BNL-12910) NEW MULTI-PERIODIC DRIFT TUBE STRUCTURE. Giordano, S. (Brookhaven National Lab., Upton, N. Y.). Oct. 1, 1968. 16p. Dep. CFSTI.

Improvement of the multi-stem drift tube linac structure by introducing transverse stem resonances (TS modes) is described. Considerable improvement in the stiffening (reduction of field variation due to frequency perturbation) can be obtained by this structure. Various transverse tuning devices are discussed, and TS dispersion curves presented. (W.H.K.)

3858 (CERN-68-36) FAST CHANGING OF RF PHASE IN A LINEAR ACCELERATOR. Bramham, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Oct. 15, 1968. 42p. Dep.

Beam loading in a linear accelerator cavity may be compensated by an increase in rf input power at the start of beam passage. If one amplifier chain is used both to fill the cavity and to supply beam power, the phase of the rf must be changed quickly. The various types of electronic phase-shifters are discussed, and two types, one switched and the other continuous, are considered in detail. Measurements on models are described, and performance limits predicted. (auth)

3859 (CERN-68-38) FOURTH-ORDER COUPLING RESONANCE EXCITED BY SPACE-CHARGE FORCES IN A SYNCHROTRON. Montague, B. W. (European Organization for Nuclear Research, Geneva (Switzerland)). Oct. 29, 1968. 45p. Dep.

The coupled notion between two transverse co-ordinates of a particle beam arising from the space-charge forces is discussed. The effects of the coupling in beams which have unequal emittances

in the two beams, so-called flat beams, are examined in detail. (B.G.D.)

3860 (COO-1195-141) THE ZGS 7^0 NEUTRAL BEAM SURVEY. Technical Report 173. Frank, J. S.; Glaubman, M. J.; Thatcher, R.; Wattenberg, A. (Illinois Univ., Urbana. Dept. of Physics). Sept. 1968. Contract AT(11-1)-1195. 14p. Dep. CFSTI.

The momentum distribution and intensity of K_L^0 mesons and the background of neutrons were measured in the 7° neutral beam of the Argonne Zero-Gradient Synchrotron. The momentum spectrum of the kaons was determined by observing regenerated K_S^0 decays into $\pi^+\pi^-$ in a momentum analyzing spark chamber system. The integrated neutron background was determined by inserting thicknesses of Lucite into the beam and observing count rates. (B.G.D.)

3861 (COO-1766-10) TANDEM VAN DE GRAAFF PREOPERATIONAL RESEARCH. Interim Progress Report, January 1, 1968-October 1, 1968. Leachman, R. B. (Kansas State Univ., Manhattan. Dept. of Physics). Oct. 1968. Contract AT(11-1)-1766. 17p. Dep. CFSTI.

Research at Kansas State University is briefly discussed. Isomer fission and particle capture gamma ray studies including gamma rays from neutron capture, Doppler shift, (p,γ) reactions on analog resonances in f-p shell nuclei, and (p,γ) reaction on T = 3/2 analog resonances in sodium-21 are described. Also discussed are inelastic proton scattering from odd-A nuclei, atomic channeling, charge-changing cross sections and ionization, and alignment development with lasers. Publications, reports, and talks are listed. (W.H.K.)

3862 (KURRI-TR-29) OPERATION AND ADMINISTRATION OF THE KURRI LINEAR ACCELERATOR. 1. AN OUTLINE OF THE LINAC AND ITS PERFORMANCE TEST. Shibata, Toshikazu; Fujita, K. (Kyoto Univ. (Japan). Research Reactor Inst.). Nov. 1966. 17p. (In Japanese and English). Dep.

The KURRI linear accelerator, made by High Voltage Engineering Co. of the USA, was completed in 1966. The electrons are injected through a 100 kV Cockcroft-Walton generator from the grid-controlled electron gun, and accelerated by L-band (1300 MHz) microwaves through a 2-m accelerating tube. To the linac are installed the beam extension-deflector device and 20-m neutron flight tube. Preparations are in progress for the experiments using the linac. With a view to benefiting such experiment plans, a description is made of the linac itself, the beam-deflecting device, the associated laboratories, and the results of its performance test. (NSA of Japan)

3863 (LNF-68/55) PROBLEMS OF SHIELDING CONNECTED WITH INCREASING THE INTENSITY OF THE FRASCATI ELECTRON SYNCHROTRON. Note No. 415. Pelliccioni, M.; Picchi, P.; Verri, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Sep[t]. 19, 1968. 10p. (In Italian). Dep.

Shielding calculations were made due to increasing the beam intensity of the Frascati electron synchrotron to 10^{12} electrons at 1.00 GeV. (B.G.D.)

3864 (NP-17608) SOME QUESTIONS OF THE THEORY OF LINEAR ACCELERATION OF CHARGED PARTICLES. Krasovitskii, V. B. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1966. 68p. (In Russian). Dep. Thesis.

This dissertation deals with the possibility of creating accelerators using mm and light frequency radiation for the acceleration of charged particles. The possibility of creating waveguide systems to obtain these short wavelengths is reviewed. It is noted that the accuracy of preparing diffraction gratings is sufficient. It is shown that it is possible to focus the field close to the waveguide axis. Problems of creating a horizontal component of the accelerating field, and of focusing electromagnetic energy in a nonlinear resonance medium without dissipation are discussed. The possibility of using the effect of the self focusing of traveling electromagnetic waves in a nonlinear medium is applied to the focusing of electromagnetic energy in a linear accelerator. The Cherenkov amplification of a longitudinal wave by a beam of charged particles in a nonlinear dielectric under resonance conditions is presented, and an expression for the maximum amplitude of the wave is obtained. The possibility of exciting nonlinear waves having a fixed phase by a beam of charged particles in a plasma is investigated. (TTT)

3865 (RHEL/M-112) PRELIMINARY DATA FROM SHIELDING MEASUREMENTS USING THE NIMROD EXTERNAL PROTON BEAM. Shaw, K. B.; Laws, D.; Thomas, R. H.; Stevenson, G. R.; Perry, D. R.; Burrells, W.; Radcliffe, D.; Towers, J. A. (Rutherford High Energy Lab., Chilton (England)). Sept. 1966. 27p. Dep.

Radiation measurements in the external 7-GeV proton beam vault and wall shielding are reported and their significance discussed. (auth)

3866 (RHEL/R-167) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, January 1-March 31, 1968. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). May 1968. 26p. Dep. CFSTI. UK 4s. 6d.

The Nimrod beam was on for High Energy Physics Research for 82% of the scheduled operating time. Six experiments were continued and six commenced. A description is given of the debuncher phase ramping system, which has materially increased the beam intensity of Nimrod. A new type of vacuum fast shut-off is described. Radiation dosimetry associated with Nimrod and its extracted proton beam XI is discussed. Some techniques of radiation dose rate measurements in Experimental Hall 1, with survey results, are described. (auth) (UK)

3867 (UCRL-18442) OPTICS OF THE AXIAL INJECTION LINE FOR THE 88-INCH CYCLOTRON. Resmini, F. (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1968. Contract W-7405-eng-48. 22p. Dep. CFSTI.

A new axial injection beam transport line has been designed for the 88-inch cyclotron. The line uses polarized ion and duoplasmatron ion sources, electrostatic quadrupole triplet lenses with a 7.3-cm aperture, sets of collimators within every triplet, deflection plates, bunches, and three sets of monitoring equipment. The beam optics including matching requirements, and transmission efficiencies, of the line are discussed. (B.G.D.)

3868 MEASUREMENT OF THE POLARIZATION OF SYNCHROTRON RADIATION. Nagakura, Ichiro; Ishii, Takehiko; Ichikawa, Kouichi; Matsuoka, Genya; Sagawa, Takasi (Tohoku Univ., Sendai). Jap. J. Appl. Phys., 7: 1416(Nov. 1968).

A method for measuring the polarization of monochromatic x rays in the region of several Angstrom and its application to the measurement of the polarization characteristics of soft x rays from the electron synchrotron at the Institute for Nuclear Study, the University of Tokyo, are described. (M.O.W.)

3869 ELECTROMAGNETIC FIELD OF TRAVELING CHARGE IN BEAM DUCTS. Hirakawa, Hiromasa (Tokyo Univ.). Jap. J. Appl. Phys., 7: 1401-12(Nov. 1968).

Electromagnetic field generated by traveling charges in a beam duct and resulting forces exerted on them are studied. Potentials for ellipsoidal charge distributions are computed in a cylindrical duct and in a parallel plate duct, with the aid of Green functions. The results are compared with corresponding potentials in free space. For a duct with resistive wall, the whole field is expanded in a parameter α, which is proportional to (resistivity)$^{\frac{1}{2}}$. Using general expressions for the first order terms, the decelerating force on the charge, which makes up for the Ohmic energy dissipation, and the transverse forces, which cause the resistive instabilities, are obtained. (auth)

3870 ANOMALIES OF THE ENERGY OF POSITIVE IONS EXTRACTED FROM HIGH-FREQUENCY ION SOURCES. A THEORETICAL STUDY. Benoit-Cattin, Pierre; Bernard, Louis-Christian (Faculte des Sciences, Toulouse). J. Appl. Phys., 39: 5723-6(Nov. 1968).

Starting from the hypothesis of the modulation of energy of ions extracted by the high-frequency voltage, one calculates the width and the form of the energy spectrum of these ions. The variation of the energy deviation of the ions in function of the extraction voltage is obtained by applying to the extraction system the double floating probe theory. These results are in agreement with the experimental results. (auth)

3871 UTILIZATION OF A TRITIUM TARGET IN A LOW ENERGY ACCELERATOR AND VARIATION OF THE NEUTRON YIELD. Cordero, F. (Junta de Energia Nuclear, Madrid). An. Fis., 64: 25-32(Jan.-Feb. 1968). (In Spanish).

Measurements of the rate of decrease in yield of neutrons from thick tritium-titanium targets have been made. The targets were used in a low-energy accelerator (150 keV) to obtain a pulsed neutron source. The geometry and the operating conditions of the targets are described in connection with the study of the factors affecting the practical service life. All targets were subjected to moderate deuteron current, from 30 to 200 μA, at an acceleration voltage of 150 kV (peak current 3 to 4 mA, pulse length 1-3 msec, duty ratio 2-5%). The yield dropped rapidly to one-half when the integrated current reached 0.7 to 1 C (2.5 to 3 hours half-life at 50 μA). The neutron flux drops to about a factor of 10 after 5 C. No noticeable drop in the target's neutron yield was observed after 50 C. The discussion relates mainly to the processes which determine the life of tritiated targets. (auth)

3872 GAMMA-RAY PRODUCTION CROSS SECTIONS MEASURED WITH A LINAC. Orphan, V. J.; Hoot, C. G.; Carlson,

A. D.; John, J. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 702 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3873 REMOTE SYSTEMS REQUIREMENTS OF ACCELERATORS. Wilson, Mahlon T. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 616 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3874 HIGH-ENERGY ACCELERATORS: PRESENT STATUS AND FUTURE PROSPECTS. Fiorentini, Paola. Com. Naz. Energ. Nucl., Notiz., 14: No. 10, 52-70(Oct. 1968). (In Italian).

A review of the world's main projects in the field of high-energy accelerators including CERN'S 300 GeV PS; the 200 GeV PS at Weston, US; the 70 GeV PS now in operation at Serpukhov, USSR; the SLAC linear accelerator in the US; and others is presented. (auth)

3875 BEAM SHUT-OFF ELECTROMETER (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE-1782).

47 drawings.

An electrometer used in sensing low currents from an ion chamber or chambers is described. The ion chambers are located about the exterior of the Stanford Linear Accelerator end stations and main research buildings. In the event radiation outside the buildings reaches an unsafe level, the ion chamber detecting the radiation sends a signal to the electrometer so that the accelerator is shut off immediately. (For details see TID-4100 Suppl. 49) (F.S.)

3876 BEAM SPILL CONTROL FOR A SYNCHROTRON. Lothrop, Fred H. G. (to United States Atomic Energy Commission). U. S. Patent 3,412,337. Nov. 19, 1968.

An electronic circuit for use with synchrotrons for spilling a controllable quantity of the particle beam current at a controllable rate onto a target adjacent the beam orbit is described. The amplitude of the radiofrequency accelerating potential is reduced so that some of the particles lose phase stability and orbit into a target. The quantity and rate of beam spill is stabilized by providing negative feedback from a detector measuring the quantity of current present in the recirculating particle beam. (AEC)

3877 ION SOURCES WITH LOW ELECTRICAL POWER CONSUMPTION FOR SMALL ION CURRENTS. Fiedler, Otto. Exp. Tech. Phys., 15: 177-82(1967). (In German).

The ion source described of the Finkelstein type yields (at a total power consumption of 30 W, a low gas consumption, and sufficient service time on the basis of the electrical compression of the ion current in the emission outlet) ion currents of over 100 μA. In hydrogen operation, the ratio of the hydrogen ions produced is $H_1^+ : H_2^+ : H_3^+ = 1 : 11 : 1$. On the basis of the low degree of dissociation, the source is well suited for the production of molecular ions. The source gives under long-term operation an ion current of satisfactory constancy. (tr-auth)

3878 BETATRON: A RADIATION GENERATOR FOR RADIOTHERAPY. Petersilka, Ernst (Siemens Aktiengesellschaft, Wernerwerk fuer Medizinische Technik, Erlangen, Ger.). Siemens Rev., 35: 379-85(Oct. 1968).

X-rays are produced when fast-moving electrons impinge on matter. Their penetrability depends upon the energy. For therapy both x-rays and electrons can be used. Their growth-inhibitory effect on cancer tissue is primarily due to ionization. Radiation energies of several MeV are required for therapy. In the betatron they are produced by accelerating electrons in a rapidly changing magnetic field. The betatron and the design of the radiation head are described. A few technical details of the 18-MeV and 42-MeV betatron are discussed. (auth)

3879 ON SOME VARIANTS OF PARAMETER CHOICE OF CIRCULAR ACCELERATOR DRIVING AND FOCUSING SYSTEMS. Kozubovskaya, I. G.; Sharshanov, A. A.; Shendrik, V. A. (Kiev Inst. of Mathematics, Kharkov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 13: 1424-30(Sept. 1968). (In Russian).

The functionals are investigated by means of which the best accelerator construction can be chosen after solving the corresponding problem of the conditional variation type. (auth)

3880 MONOISOTOPIC TARGETS Ti, Zr, AND Hf FOR NUCLEAR INVESTIGATIONS. Lishenko, L. G.; Nazarova, T. S.; Rozen, A. A.; Reshetova, L. N. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 4, 37-8 (July-Aug. 1968). (In Russian).

The method of obtaining monoisotopic foils of Ti, Zr, and Hf from 1 to 10 mm thick from oxides of these metals is described. Foils were obtained by thermal decomposition of iodides of these metals on a heated substrate of molybdenum in a vacuum. The optimum conditions for reduction of the initial oxides of these isotopes with subsequent iodination and decomposition on substrates are discussed. Data on gas analysis of the foils are presented. (tr-auth)

3881 SOLID MULTILAYER TRITIUM TARGETS FOR NEUTRON GENERATORS. Katsaurov, L. N.; Kuznetsov, A. N.; Surkova, I. V. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 4, 35-6 (July-Aug. 1968). (In Russian).

The results of an experimental investigation on solid three-layer tritium targets used in d-T neutron generator are given. The yield from such targets is about ten times less than with neutron generators using deuterium targets. It improves significantly the monochromatic properties of the neutron beam. (tr-auth)

3882 THE COMBINED RESONANCES INDUCED BY THE CROSS COMPONENTS OF THE HIGH-FREQUENCY ACCELERATING FIELD IN CIRCULAR ACCELERATORS AND STORAGE RINGS. Barkhudaryan, A. V.; Orlov, Yu. F. (Inst. of Theoretical and Experimental Physics, Moscow. Inst. of Physics, Erevan). Prib. Tekh. Eksp., No. 4, 17-20 (July-Aug. 1968). (In Russian).

The combined resonances which are induced in circular accelerators and storage rings when there exists a relation between the frequency ω of the accelerating field and the combined frequency of the type $q\omega_s - (mv_z + nv_r)\omega_s$ were examined. The possibility of particle acceleration with constant frequency of the accelerating field independent of the increase in speed of the particle during acceleration was studied. It was shown that simultaneous with the increase of energy the buildup of betatron oscillations excludes the possibility of the cyclotron regime with the absence of damping processes. (tr-auth)

3883 FORMATION OF ELECTRON BUNCHES OF SMALL PHASE LENGTH IN THE ACCELERATOR INJECTOR. Ostrovskii, E. K.; Zykov, A. I.; Kramskoi, G. D.; Vishnyakov, V. A. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 4, 22-5 (July-Aug. 1968). (In Russian).

An apparatus is described for obtaining electron bunches with sharply defined boundaries at the entrance of a linear accelerator injector with a constant phase velocity. (tr-auth)

3884 OPTIMIZATION OF TOTAL ENERGY MEASUREMENTS OF SYNCHROTRON RADIATION. Yakushin, V. V. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 4, 30-2 (July-Aug. 1968). (In Russian).

A detailed analysis of the sources of error in measuring the total energy of synchrotron radiation by an integral monitor, which has an accuracy of not worse than 1%, is presented. (tr-auth)

3885 AN APPARATUS FOR ORIENTATION OF A MONOCRYSTALLINE TARGET FOR AN ELECTRON SYNCHROTRON. Kuz'min, V. N.; Sertakov, Yu. I.; Epaneshnikov, V. D. (Scientific Research Inst. of Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Prib. Tekh. Eksp., No. 4, 33-4 (July-Aug. 1968). (In Russian).

A goniometer for orientation of monocrystals in the vacuum chamber of 1.53 GeV electron synchrotron both around horizontal and vertical axes within the limits ±2.5° and ±45°, respectively, and an accuracy not worse than 10 min. The goniometer is a remote controlled system with dimensions 620 × 460 × 330 mm^3. (tr-auth)

3886 DESIGN AND PERFORMANCE OF A FOCUSING MAGNETIC CHANNEL FOR A VARIABLE ENERGY MULTIPARTICLE CYCLOTRON. Odera, M.; Miyazawa, Y.; Tonuma, T.; Hemmi, M.; Terajima, O. (Inst. of Physical and Chemical Research, Yamato, Japan). Nucl. Instrum. Methods, 65: 247-52(Nov. 15, 1968).

Design of a focusing magnetic channel which is to be used for the compensation of defocusing effect of the fringing field of the cyclotron is described. It can be used in the wide range of magnetic field strength giving essentially the same beam trajectories for the variable energy, multiparticle operation without any readjustments. Practical design and performance in the IPCR cyclotron are given. (auth)

3887 CALCULATION OF THE PROFILES OF ELECTRODES USED FOR THE RADIAL ACCELERATION OF A BEAM OF CHARGED PARTICLES FROM WHICH THE ENVELOPE IS CONSTITUTED BY A DISC. Zankel, K. (CEN, Grenoble, France). Nucl. Instrum. Methods, 65: 322-6(Nov. 15, 1968). (In French).

Space charge flow between two coaxial cylinders has been studied. In order that space charge may be neglected, the neces-

sary potential difference has been calculated. A smoothing procedure has been used for designing electrodes which match the conditions required for a thin slice-shaped beam. The results for three cases have been plotted. (auth)

3888 UTILIZATION POSSIBILITIES OF REPLACED WORN-OUT PARTS FROM THE CYCLOTRON U-120. Svoboda, K.; Randa, Z.; Hruby, J. (Inst. Nuclear Research, Rez, Czech.). Int. J. Appl. Radiat. Isotop., 19: 887-8(Dec. 1968).

Some parts of the accelerating chamber of this cyclotron are constructed from molybdenum, especially the cyclotron septum. These parts are in general, after some months of operation, removed and changed for new ones. Up till now these parts have been discarded into radioactive wastes. However, they represent a potential source of some radioactive preparations. This was the reason for studying the radionuclides produced in molybdenum by bombarding with 12.5 MeV deuterons. ^{95m}Tc seems to be the only radioisotope which is worthwhile isolating from the worn-out molybdenum cyclotron parts. (auth)

3889 4.5-MeV ELECTROSTATIC ACCELERATOR OF THE TECHNICAL PHYSICS INSTITUTE OF THE UKRAINIAN ACADEMY OF SCIENCES AND ITS USE FOR NUCLEAR RESEARCH. Tsygikalo, A. A.; Tsytko, S. P. At. Energ. (USSR), 25: 142-5 (Aug. 1968). (In Russian).

The vertical electrostatic accelerator (EA) operates in compressed gas, and is intended for precision work. It differs from other accelerators in having two accelerating tubes which operate simultaneously. In one of the tubes (the measuring tube) the low-intensity proton beam of 3 to 5 μA serves for measuring and stabilizing the particle energy. A working ion beam of 30 to 40 μA is produced in the other tube. An electrostatic analyzer with a radius of the deflecting plates R = 1500 ± 0.01 mm and a gap d = 5 ± 0.002 mm at the exit of the measuring tube serves to measure and stabilize the particle energy. The particle beam is monoenergetic to $\Delta E/E = \pm 0.05\%$. An on-line digital computer has been coupled to the accelerator in order to automate nuclear studies. As a result the efficiency of use of the machine has more than tripled, especially in the analysis of complex gamma spectra. Typical results are presented for resonances detected in the ^{27}Al (p, gamma) ^{28}Si reaction at E_p = 2650 – 3200 keV and in the ^{26}Mg (p,gamma) ^{26}Al reaction at E_p = 2322 keV. Over 120 studies have been carried out on the machine in the last 12 years in the region between ^{16}O and ^{40}Ca. This machine is being routinely produced and distributed in the USSR. (TTT)

3890 THE ISOLDE PROJECT AT CERN; THE EUROPEAN CENTRE FOR NUCLEAR RESEARCH. Kjelberg, Arve (European Organization for Nuclear Research, Geneva); Pappas, Alexis C. Tek. Ukebl., 115: 701-7(Aug. 15, 1968). (In Norwegian).

The isotope separator on line with the CERN 600 MeV synchrocyclotron has produced isotopically pure beams of krypton, tin, antimony, xenon, mercury and radon. The experimental facility is described. (auth) (Norway)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 2558, 2567, 2568, 2715, 3543, 3550, 3569, 3871, 3881, 3996, 4016, 4055, 4081, and 4446.

3891 (CCDN-NW-4) BULLETIN NO. 4. (ENEA Neutron Data Compilation Centre, Gif-Sur-Yvette (France)). Dec. 1966. 213p. Dep.

A tabulation is presented of the neutron cross sections and other parameters for nuclides from H to ^{254}Es. The value of the parameter, the minimum and maximum energies, reference, date, laboratory, and method are indicated. (J.S.R.)

3892 (KFK-791) ORGANIZATIONAL AND TECHNICAL ASPECTS IN THE FIELD OF NEUTRON NUCLEAR DATA EVALUATION. Schmidt, J. J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). July 1968. 12p. (CONF-680636-1). Dep.

From 1st International CODATA Conference, Taunus, Germany.

A brief outline of the organizational and technical aspects of the evaluation of neutron data is presented. (D.C.W.)

3893 (LA-4016) TRANSPORT THEORY: FORMULATIONS AND SOLUTIONS BY FINITE DIFFERENCE METHODS. Carlson, Bengt G. (Los Alamos Scientific Lab., N. Mex.). Sept. 14, 1968. Contract W-7405-eng-36. 21p. Dep. CFSTI.

The formulation and solution of the neutron transport equation by finite difference techniques is reviewed. The discrete as well as the centered S_n methods are discussed. Many new results, techniques, and interpretations are presented. The emphasis is on an improved approach to centered S_n and its generalization. (auth)

3894 (LFEN-86-a) THERMAL NEUTRON DIFFUSION LENGTH IN WATER AT 24°C. Martinho, E.; Salgado, J. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1968. 29p. (In Portuguese). Dep.

The thermal neutron diffusion length in water at 24 ± 1°C was measured from the attenuation of the neutron flux in the parallelipiped recipient ($B^2 = 0.10$ cm^{-2}). The value obtained, L = 2.794 ± 0.009 cm, was compared with the experimental and theoretical values reported elsewhere. From the study of the transverse distribution of the thermal neutron flux, the extrapolation length in water was determined to be d = 0.37 ± 0.02 cm. This value was also compared with recent determinations of this parameter. (tr-auth)

3895 AN ANALYSIS OF THE EFFECTS OF CROSS SECTION UNCERTAINTIES ON THE MULTITABLE S_n SOLUTION OF NEUTRON TRANSPORT THROUGH AIR. Prezbindowski, David Leon. Lafayette, Ind., Purdue Univ., 1968. 238p.

Thesis.

A rapid systematic method of evaluating the effects of cross-section measurement errors on the multigroup flux as a function of space and group was derived for a source problem in spherical geometry. The method utilizes the adjoint flux solution and was derived assuming that the source problem is being solved by a multitable S_n method. The adjoint analysis method was applied to the problem of the deep penetration of neutrons in atmospheric air. A thorough analysis of the sensitivity of the multigroup fluxes to cross-section measurement errors in nitrogen is given. Also included are comparisons of the results of the adjoint analysis method and the method of subtracting the unperturbed flux solution from a flux solution which is perturbed due to cross-section perturbations. A comparison of computational time required by the two methods is included. The sensitivity analysis of the cross section measurement errors in nitrogen shows that the adjoint analysis method results give a valuable insight into the space and energy variation of the sensitivity of the neutron flux to cross-section measurement errors. The comparison of the adjoint method with the method of subtracting perturbed and unperturbed fluxes shows that the results of these methods are in essential agreement. The comparison of computational times required by the two methods to analyze three different problems shows that the adjoint method requires from one-quarter to one-tenth less computational time. (Disser. Abstr.)

3896 NEUTRON WAVE PROPAGATION THROUGH AN INTERFACE. Baldonado, Orlino Castro. Los Angeles, Univ. of California, 1968. 280p.

Thesis.

Neutron wave propagation in a system consisting of two half spaces having different properties, adjacent at x = 0 was investigated using four different models: model A, one-speed diffusion theory; model B, one-speed transport theory; model C, energy-dependent diffusion theory; and model D, energy-dependent transport theory. An oscillating source at $x = -\infty$ in medium (1) was assumed, and the scattering kernel in models B and D was assumed to be one-term degenerate. The solutions are identified in terms of incident (I), reflected (R), and transmitted (T) components. Defining the discrete (continuum) waves to be those with discrete (continuum) propagation constants, both discrete and continuum waves existed for models B, C, and D. Line continua were in models B and C, and there was an area continuum in model D. A limit frequency ω_L exists, and for $\omega > \omega_L$, only continuum waves can propagate in models B and D. For $\omega < \omega_L$, a purely discrete incident wave gives rise to a mixture of discrete and continuum waves in models B, C, and D. The propagation constants $k = \alpha + i\beta$ for the discrete waves were computed, together with $\alpha^2 - \beta^2$, and $2\alpha\beta$, as a function of frequency. The elementary solutions for each model were found, and these were used to write the general solution. Except for model C where the continuum solutions were neglected in the evaluation of the expansion coefficients, the analyses given are exact. The continuum coefficients in model B were evaluated by solving an inhomogenous Riemann–Hilbert problem, and the continuum coefficients for model D were evaluated by solving a generalized Riemann–Hilbert problem. Integral conditions resulted which allowed the evaluation of the discrete coefficients. Interface effects were separable from energy effects in models C and D. The energy appears as an amplitude and a phase shift and does not affect the propagation constants of the discrete waves. There is good agreement of the energy dependence of the waves as given by models C and D. The numerical calculations show that neutrons having lower energies are characterized as waves with larger phase shifts and smaller amplitudes. Interface effects, as manifested through R, are seen to be negligible after a few (>5) mean free paths from the interface. The angular variable μ in model B, the energy E in model C, and μ and E in model D were integrated out, and the discrete, reflected, and transmitted components of the waves were computed at the interface. R shows the same trend for the four models. However, T for the two diffusion models A and C is different from the T of the two transport models B and D. The difference is explained in terms of the continuum contribution. (Disser. Abstr.)

3897 PRODUCTION OF A WELL-COLLIMATED NEUTRON BEAM USING THE ASSOCIATED-PARTICLE TECHNIQUE. Tripard, Gerald Edward. Vancouver, B. C., Univ. of British Columbia, 1967.

Thesis.

An accurately collimated monoenergetic fast neutron beam of small angular width was produced by bombarding a deuterium target with 2-MeV deuterons. Background reduction was achieved by using the associated-particle technique and extensive shielding. Dual-parameter pulse-height analysis was used to reduce the coincidence time resolution between the detected neutrons and the associated ^{3}He recoil particle to 4.5 nanosec by taking into account the variations in flight times of the ^{3}He particles. A rotating thin film deuterated polyethylene target was developed which enabled a substantial increase in the neutron flux to be made. The beam of 70 neutrons/second/millisteradian produced, was of sufficient intensity to perform a small angle scattering experiment. The technique was tested by a measurement of the angular distribution from 40 to 10° of neutrons elastically scattered from lead. (Disser. Abstr.)

3898 THE DIAGRAM TECHNIQUE IN THE THEORY OF MULTIPLE SCATTERING. Kalashnikov, N. P. (Comitato Nazionale per l'Energie Nucleare, Bologna). Nuovo Cim., 58B: 279-88(Nov. 11, 1968).

A quantum-mechanical approach is used to obtain an analytic solution of the multiple-scattering problem for neutrons. A graphic representation is obtained for the average transition probability. This average transition probability is represented by the sum of ladder diagrams each of which describes a certain number of scattering processes. For the case of an infinite slab, the ratio of n-times scattered neutron intensity to (n – 1)-times scattered neutron intensity was calculated. (auth)

3899 ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY IN THE FAST DOMAIN. Nicolaenko, Basil. Ann Arbor, Mich., Univ. of Michigan, 1968. 233p.

Thesis.

Some aspects of the energy-dependent, static neutron transport equation, using a continuous energy formulation (rather than a multigroup scheme) are examined. Emphasis is placed on condi-

tions of interest for the high-energy (fast) domain: both fission, inelastic, and elastic slowing-down kernels are included in the analysis. As a first step, focusing on inelastic slowing-down problems, a synthetic inelastic scattering kernel is studied: such a synthetic operator is separable, but not degenerate. A new energy-transformation is introduced, the application of which yields a particularly simple expression for the Boltzmann equation with inelastic slowing-down and without regeneration. Exact solutions of the latter equation are found for various boundary conditions, using Case's method of singular normal modes and inversion formulae for the new energy-transformation. Asymptotic expressions are derived. The properties of the transport equation with simultaneous fission regeneration and slowing-down are studied, under the assumption of plane symmetry and simple cross-sections laws permissible in the fast domain. One draws the following conclusion: in order to achieve completeness for the normal modes, solutions of the Boltzmann equation with fission and slowing-down, one must consider fundamental space-energy separable modes reflecting the multiplicative process together with "slowing-down transients"; the "slowing-down transients" are solutions of a plain slowing-down equation with no regeneration; they characterize the spatial adjustment of the neutron distribution from the initial high-energy source to the final degraded asymptotic energy spectrum. These theoretical predictions are compared with experimental observations and measurements on fast multiplying media. In many situations (typically, the fast exponential experiment), workers have tried to measure a well-defined space-energy separable asymptotic neutron distribution; however, it has been suspected that an actual equilibrium was not reached. The present work sheds some light on this question, by making a semi-quantitative evaluation of the physical importance of "slowing-down transients" in the approach to equilibrium in fast exponential experiments. The theoretical model is adjusted to experimental conditions and data in ZPR-IV systems (moderately enriched fast exponential assemblies). From the numerical results, one sees the limitations of the validity of asymptotic transport theory (including most multigroup schemes) for insufficiently large and too subcritical experimental systems related to integral experiments on fast dilute multiplying media. (Disser. Abstr.)

3900 NEUTRON ENERGY SPECTRA OF DIFFERENT SIZE ^{239}Pu–Be(α,n) SOURCES. Anderson, M. E.; Neff, R. A. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc., 11: 454(Nov. 1968).

3901 THEORY OF NEUTRON WAVE PROPAGATION. Duderstadt, James J. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc., 11: 438(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3902 METHOD OF CALCULATING EFFECTIVE THERMAL-GROUP CROSS SECTIONS USING SPACE- AND ENERGY-DEPENDENT NEUTRON FLUXES. Kier, P. H.; Tapucu, A. (Istanbul Technical Univ., Turkey). Trans. Amer. Nucl. Soc., 11: 436-7 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3903 SIMPLE ANALYTICAL MODELS FOR STUDYING FAST-NEUTRON SPECTRA. Malakoff, R. I.; Malaviya, B. K. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 608-9(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3904 PULSED-NEUTRON MEASUREMENTS IN GRAPHITE. Shapiro, J. L. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc., 11: 584-5(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3905 PULSED-NEUTRON EXPERIMENTS IN WATER IN THE BUCKLING RANGE 0.06 TO 1.80 cm^{-2}. Cokinos, D.; Melkonian, E. (Columbia Univ., New York). Trans. Amer. Nucl. Soc., 11: 585-6(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3906 SELF-SHIELDING FACTORS BY THE LADDER METHOD. Segev, M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 593(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3907 PURELY DISCRETE NEUTRON WAVE PHENOMENA IN THE CONTINUUM REGION. Dorning, J. J.; Thurber, J. K. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 580-1(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3908 AN EXPLANATION OF THE APPARENT VIOLATION OF THE MAXIMUM ABSORPTION THEOREM. Dorning, John J.; Thurber, James K. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 579-80(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3909 RADIATION TRANSPORT OPERATORS VIA THE GENERALIZED RICCATI TRANSFORMATION. Young, Frederick D.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 549-50(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3910 NEW DEFINITION OF THE MICROSCOPIC MULTIGROUP TRANSPORT CROSS SECTIONS. Travelli, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 532-3(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3911 THE SYNTHETIC METHOD AS APPLIED TO THE S_N EQUATIONS. Gelbard, E. M.; Hageman, L. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 529-30(Nov. 1968).

3912 OPTIMAL NEUTRON GROUP STRUCTURE. Harms, A. A.; McCormick, N. J. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc., 11: 527-8(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3913 SPECTRUM SYNTHESIS WITH SPATIALLY DISCONTINUOUS BASIS SPECTRA. Vaughan, E. U.; Rose, P. F.; Hausknecht, D. F. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 528-9(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3914 REENTRANT HOLE EFFECTS IN FAST-NEUTRON SPECTRA. McGirt, F.; Becker, M. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 610(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

3915 NUCLEAR DESIGN PARAMETERS FOR A MONOENERGETIC NEUTRON SOURCE. Lehman, Richard L. (Univ. of California, Los Angeles). Int. J. Appl. Radiat. Isotop., 19: 841-4(Dec. 1968).

The nuclear design parameters in the construction of a monoenergetic laboratory neutron source were evaluated. The most promising reaction was $^{13}C(\alpha,n)^{16}O$, employing ^{210}Po or ^{242}Cm, that is expected, because of strong emission anisotropy, to yield about 13,000 neutrons/s Ci in forward and backward 7% FWHM peaks centered at 6.45 and 4.25 MeV. The peak positions and energy spreads were obtained by use of a graphic-numerical analysis of thin target data. The efficiencies and emission properties of two source configurations are presented and discussed. (auth) (UK)

3916 CONSTRUCTION OF FAST NEUTRON GENERATOR TUBES. Bobrowski, C.; Chrusciel, E.; Massalski, J.; Starzec, A. (Inst. of Nuclear Techniques, Krakow). Isotopenpraxis, 4: 352-8(Sept. 1968).

The construction and operating principles of neutron generator tubes designed for geophysical purposes and activation analysis are described. The influence of ion source parameters on the current and consequently on neutron output is discussed. The output obtained with geophysical tubes was of the order of 10^8 n/sec. On the basis of the measurements of ion current, which mainly consists of monoatomic ions, it is expected that the output of the neutron tube designed for activation analysis will be of the order of 10^{10} n/sec. (auth)

3917 A PULSED-NEUTRON INVESTIGATION OF THE EFFECT OF TEMPERATURE ON THE DECAY OF A THERMAL-NEUTRON POPULATION IN H_2O ICE. Silver, Ernest G. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 34: 275-84 (Dec. 1968).

The pulsed-neutron method was used with ice cylinders in the buckling range from 0.039 to 0.739 cm^{-2} over temperatures between –5 and –85°C. The purpose was to determine whether there would be early establishment of an asymptotic neutron spectrum

and, since this proved to be so, to measure the neutron diffusion parameters. The neutron decay data were analyzed by using a nonlinear least-squares fitting method with two exponential modes. The resulting diffusion parameters are compared with those found by other workers for H_2O at various temperatures, and the effect of the solid-liquid phase transition on the diffusion coefficient and diffusion cooling coefficient is discussed. (auth)

3918 INELASTIC SCATTERING OF THERMAL NEUTRONS IN GRAPHITE. Carvalho, F. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng., 34: 224-36(Dec. 1968).

The Karlsruhe rotating crystal time-of-flight spectrometer was used to measure the slow neutron scattering law of graphite in a range of energy transfer of 7 to 180 meV and momentum transfer of 1.5 to 16 $Å^{-1}$. The graphite samples were heated to a temperature of 533°K, thereby increasing the probability of scattering with high energy transfer. The experimental data are corrected for multiple scattering in the sample using the incoherent approximation. The corrected data are in good agreement with calculated scattering law values. Large discrepancies between theory and previous experimental results are thus satisfactorily explained. The coherent nature of inelastic scattering in graphite is apparent in the data, especially in the region of lower energy and momentum transfers. The possibility of using the experimental results in this region directly to test and eventually to correct lattice model parameters is discussed. It is suggested that further measurements in this region with higher energy resolution might yield useful information. A phonon frequency distribution is extrapolated from the data and is used to calculate several integral quantities. The values obtained are compared with previous theoretical and experimental results. (auth)

3919 SENSITIVITY OF NEUTRON TRANSPORT IN OXYGEN TO VARIOUS CROSS-SECTION SETS. Straker, E. A. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 34: 332-6(Dec. 1968).

Monte Carlo calculations were made for the transport of fission neutrons in oxygen in order to determine the sensitivity of transport calculations to cross-section detail. An isotropic point fission source in an infinite medium of liquid oxygen was considered. (D.C.W.)

3920 SELF-SHIELDING FACTORS FOR SCATTERING DOMINANT NEUTRON RESONANCES. Roach, W. H. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng., 34: 331-2 (Dec. 1968).

A method for calculating resonance self-shielding factors for detector materials in which $\Gamma_n \gg \Gamma_\gamma$ in the principal resonance is outlined, and results are given for Co and Mn foils. (D.C.W.)

3921 EVALUATION OF NEUTRON ABSORPTION RATES BY ACTIVATION MEASUREMENTS OF SPECTRAL INDEXES. Pistella, F. (CNEN, Rome). Nucl. Sci. Eng., 34: 329-31 (Dec. 1968).

It is shown that an evaluation of the range of values of an unknown reaction rate can be obtained from measured activation rates only, with no determination of the actual neutron spectrum itself. The technique can be applied to spectra that are strongly perturbed by the presence of a resonance absorber. (D.C.W.)

3922 THE EVALUATION OF AN ITERATIVE TECHNIQUE'S USE IN UNFOLDING NEUTRON SPECTRA DATA. Watkins, Goldie L.; Holeman, George R. (Yale Univ., New Haven). Health Phys., 15: 535-9(Dec. 1968).

Investigators are frequently confronted with the problem of inferring the spectrum of a neutron source from the neutrons activating a neutron detector. This involves the solution of a flux integral equation for the energy distribution of these neutrons. An iterative technique developed by Scofield and Gold, and modified by O'Brien, was used to solve a matrix approximation to a flux integral equation for two hypothetical spectra and a Pu–Be neutron spectrum. The data for the study were obtained from a Bonner-sphere counting system and its response matrix. Both the response matrix and the counting system are based on the activation of a LiI(Eu) scintillation crystal by thermalized neutrons. Higher neutron energies are detected by covering the crystal with 2-, 3-, 5-, 8-, and 12-in.-diameter polyethylene spheres and a 0.03-in.-thick cadmium cap. (auth) (UK)

3923 APPLICATIONS OF A MACROSCOPIC FORMULATION OF TRANSPORT THEORY. Pfeiffer, W.; Shapiro, J. L. (California Inst. of Tech., Pasadena). Nucl. Sci. Eng., 34: 336-9(Dec. 1968).

A macroscopic formulation of neutron transport theory is outlined in which reflection and transmission matrices for a given thickness of material are used instead of cross sections as the input information. Relations for extrapolating to other thicknesses of material are given, and some applications of the macroscopic approach are discussed. (D.C.W.)

3924 MEASUREMENT OF THE ANISOTROPY OF SCATTERING OF NEUTRONS. Santiago, S. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 171-6(May-June 1967). (In Spanish).

Pulsed measurements of diffusion constants in anisotropic media with slab geometry are presented. The system was composed of alternating slabs of aluminium and polyethylene, combined in two different volume ratios. Values for the diffusion coefficients in the directions parallel and perpendicular to the slabs were obtained and were compared with recent transport calculations. (auth)

3925 AN ANALYSIS OF METHODS FOR CALCULATING SPATIALLY DEPENDENT NEUTRON SLOWING DOWN DISTRIBUTIONS. Amster, Harvey J. (Univ. of California, Berkeley). Nucl. Sci. Eng., 34: 313-27(Dec. 1968).

The accuracies of some common approximate methods for calculating spatially dependent neutron slowing down distributions are tested. According to each procedure, an analytic expression for the detailed distribution of neutrons from a plane monoenergetic source in hydrogen is obtained and compared with accurate analytic solutions. Most of the latter are derived here and appear to have other far reaching potential applications. In particular, the exact value and first two lethargy derivatives of the collided angular flux at source lethargy are found in terms of elementary functions of position and angle. These results are used to show that an expression derived by McInerney for the spatial distribution of the scalar flux has, at any given position, only first-order accuracy in powers of lethargy, even though the zeroth and second spatial moments are exact at all lethargies. While the B-1 and P-1 approximations produce poor results at small lethargies, they are accurate at large values; for the errors are due primarily to high-order spatial Fourier components, and these rapidly decay with increasing lethargy. At any lethargy, a Tauberian theorem facilitates calculating the spatial derivative of the scalar flux at the source plane. This quantity is used to trace the lethargy dependence of some peculiarities of the entire spatial distributions given by the B-1 and P-1 approximations. At asymptotically large lethargies, these spatial distributions are obtained explicitly and shown to agree with a well-known accurate expression. (auth)

3926 THEORY OF NEUTRON WAVE PROPAGATION. Duderstadt, James Johnson. Pasadena, Calif., California Inst. of Tech., 1968. 201p.

Thesis.

An exact theory of neutron wave propagation in non-multiplying media was developed. This theory was used to analyze current experimental work. An initial study was made of the eigenvalue spectrum of the velocity-dependent Boltzmann transport operator for plane wave propagation in both noncrystalline and polycrystalline moderators. The point spectrum is discussed in detail, and a theorem concerning the existence of discrete eigenvalues for high frequency, high absorption, and/or small transverse dimensions is demonstrated. The limiting cases of low and high frequency behavior were analyzed. A physical interpretation of the discrete and continuum eigenfunctions (plane wave modes) is given, and the point spectrum existence theorem is explained in the light of such interpretations. Using this spectral representation, a technique for solving full-range boundary value problems for a general noncrystalline scattering kernel is presented. Orthogonality and completeness of the eigenfunctions are demonstrated, and the problem of a plane source at the origin of an infinite medium is solved. This solution is compared with that obtained by a Fourier transform technique. A procedure for solving half-range boundary value problems is presented for a one-term separable kernel model. For purposes of illustration, the problem of an oscillating source incident upon the boundary of a half-space is solved. The difficulty in extending the half-range theory to more general scattering models is discussed. The theory is used to analyze recent neutron wave experiments in graphite and D_2O parallelepipeds. To facilitate the interpretation of the general solution, the inelastic scattering kernel is approximated by a separable kernel, while the elastic scattering is modeled with a Dirac δ-function. The eigenvalue spectrum is analyzed in some detail, revealing several interesting conclusions concerning the experimental data and methods of data analysis. Several modifications in experimental design and analysis are suggested. The agreement of the theory with experiment is sufficient to warrant its application to the analysis of more complicated experiments (multiple-region, multiplying media, pulse

propagation, etc.). Several suggestions for such extensions are indicated. (Disser. Abstr.)

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Refer also to abstracts 3891, 4048, 4054, and 4076.

3927 (IPNO/LA–3) APPROXIMATIONS IN THE CALCULATION OF PROTON–DEUTERON ELASTIC SCATTERING AT MEDIUM ENERGY. L'Huillier, M. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). [nd]. 14p. (In French). Dep.

The usual calculations of the proton-deuteron elastic scattering cross section are analyzed for energies of about 100 MeV. Several approximations usually made in the impulse term, such as the factorization method and the introduction of the free nucleon-nucleon scattering operator (on the energy shell), are studied. The use of a simple separable S interaction allows derivation of a ratio between the exact and approximate values of the impulse approximation term. The variations with the incident energy or the center-of-mass angle are small, and the corrections are not greater than 10%. This result is due to the properties of the deuteron wave function. It is concluded that these approximations are not responsible for the observed disagreement with respect to experiments and that consequently a multiple scattering mechanism must be involved. (auth)

3928 (LA–4011) ALPHA–ALPHA ELASTIC SCATTERING: A BIBLIOGRAPHY. Furnish, Jean (comp.) (Los Alamos Scientific Lab., N. Mex.). Sept. 6, 1968. Contract W-7405-eng-36. 23p. Dep. CFSTI.

Nuclear Science Abstracts was searched from volume 7 (1953) through volume 22 number 15 (Aug. 15, 1968) for material on the elastic scattering of alpha particles on alpha particles. The references are arranged numerically within each volume with the abstracts from the most recent volume presented first. (auth)

3929 BINDING ENERGY OF ^{3}H WITH TENSOR FORCES AND HARD-SHELL REPULSION. Dabrowski, J.; Dworzecka, M. (Univ. of Warsaw). Phys. Lett., 28B: 4-6(Oct. 28, 1968).

The results of a calculation of the triton binding energy are presented. A separable nucleon-nucleon potential with hard shell repulsion in the singlet state and with tensor force is used. (auth)

3930 "EXACT" EVALUATION OF THREE-BODY PARAMETERS: A PLEA FOR PERSPECTIVE. Mitra, A. N. (Univ. of Delhi). Nuovo Cim., 58B: 344-6(Nov. 11, 1968).

An attempt is made to put into proper perspective the practical philosophy of "exact" evaluation of three-body parameters. (D.C.W.)

3931 MEASUREMENT OF THE NEUTRON–NEUTRON SCATTERING LENGTH. Nygren, David Robert. Seattle, Univ. of Washington, 1968. 179p.

Thesis.

The neutron-neutron s-wave singlet scattering length was determined through the use of the reaction $\pi^- + d \rightarrow n + n + \gamma$. In this reaction the final-state interaction of the neutrons can produce large deviations from phase space distributions for the reaction products. To produce the reaction, negative pions from the Berkeley 184-in. cyclotron were stopped in a liquid deuterium target. All three reaction products were detected in coincidence using an annular array of fourteen liquid scintillator neutron detectors and six gamma detectors of the lead-plastic scintillator sandwich type. For each event the neutron energies were determined from measurements of the flight times between the target and the detectors. In addition, the directions of the neutrons and the gamma ray were recorded, providing two constraints for background rejection. Systematic effects due to the detector properties and the presence of background are discussed in detail. The neutron energy spectra at fixed angles and the neutron angular distribution summed over energy were analyzed. On the basis of 6000 events, the magnitude of a_{nn} was found to be 18.42 ± 1.53 F. (Disser. Abstr.)

3932 POLARIZATION OF NEUTRONS FROM THE D(d,n)^{3}He REACTION AT E_d = 80 TO 150 keV. Thomas, K.; Hofmann, A. (Univ., Erlangen-Nuernberg, Ger.). Z. Phys., 217: 128-35(1968). (In German).

The polarization of neutrons from the d-d reaction was investigated in the energy region E_d = 80 to 140 keV at an angle of $\Theta_l = 50°_{lab}$. Using a polarimeter consisting of a He-gas scintillation detector and two plastic detectors, it was possible to reduce the background to a negligible amount. A maximum of neutron polarization of −14.9 ± 2.2% was found at E_d = 100 keV. The resonance-like behavior is a further indication of an unknown excited level in ^{4}He at 23.9 MeV. (auth)

3933 TWO-DIMENSIONAL MEASUREMENTS OF THE DEUTERON BREAK-UP BY PROTONS AT E_d = 14 MeV. Kuehn, B.; Kumpf, H.; Moeller, K.; Moesner, J. (Zentralinstitut fuer Kernforschung, Dresden). Nucl. Phys., A120: 285-96(1968).

Two-dimensional coincidence spectra of the two protons from deuteron break-up by protons at E_d = 14 MeV were measured. The experimental spectra were projected on the kinematic locus. The squares of matrix elements were derived by dividing the differential cross sections by the phase space factor. The experimental results were compared with the pole graph approximation for the three-nucleon problem. (auth)

3934 MEASUREMENTS OF THE CROSS SECTIONS FOR n–d ELASTIC AND INELASTIC SCATTERING AT 14.1 MeV. Shirato, Shoji; Koori, Norihiko (St. Paul's Univ., Tokyo). Nucl. Phys., A120: 387-400(1968).

The differential cross sections for the elastic and inelastic scattering of 14.1-MeV neutrons by deuterons were measured over the angular range 0 to 50° in the lab system by detecting recoiling deuterons and break-up protons. The results for the elastic scattering are in good agreement with those of Seagrave, while the results for the inelastic scattering disagree with his work at forward angles. The integrated cross section for inelastic scattering agrees with the result of Catron et al., and the total cross section with the result of Poss et al. The agreement with the theoretical results of Aaron, Amado and Yam is fair. Except for a small discrepancy between the theoretical and experimental values of the cross sections, the energy spectrum of break-up protons observed at the mean angle of 3.9° satisfactorily fits the result of Aaron and Amado for the singlet n-n scattering length $a_{nn} = -23.78$ fm. (auth)

3935 ATOMIC MASSES OF ^{1}H, ^{16}O, AND ^{32}S. Matsuda, Hisashi; Matsuo, Takekiyo (Osaka Univ.). J. Phys. Soc. Jap., 25: 950-2(Oct. 1968).

The high-resolution mass spectrometer at Osaka University was used to measure the atomic masses of ^{1}H, ^{16}O, and ^{32}S. Mass differences of the four doublets C_3H_8–CS, C_3H_8–CO_2, CO_2–CS, and C_2H_6S–C_3H_2 were measured by using peak-matching technique; and mass values were calculated. The resulting mass values are ^{1}H = 1.007 824 99 ± 14, ^{16}O = 15.994 9121 ± 12, and ^{32}S = 31.972 0693 ± 10 u. (auth)

3936 A COMMENT ON THE POLARIZATION IN PROTON–PROTON SCATTERING AT LOW ENERGY. McKee, J. S. C.; Osborn, T. (Univ. of Birmingham, Eng.). Phys. Lett., 28B: 7-9(Oct. 28, 1968).

An estimate is made of the polarization in proton-proton scattering due to the interaction between the magnetic moment of the incident particle and the Coulomb field of the target. The effect is seen to be significant at low energies. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 2663, 3872, 3891, 3935, 3983, 4033, 4043, 4052, 4054, 4057, 4066, 4074, 4076, and 4080.

3937 (CCDN-NW–3) NEWSLETTER NO. 3. (ENEA Neutron Data Compilation Centre, Gif-Sur-Yvette (France)). Oct. 1966. 30p. Dep.

A comparison of existing data on the ^{6}Li(n,α)^{3}H reaction cross section is given. The renormalized data of Bame and Cubitt are included, as well as a revision of the data in the energy range $150 < E_n < 450$ keV presented previously by Schwarz et al. The remaining discrepancies turn out to be the question of the width of the resonance peak and how far the 1/v extrapolation is valid in the keV region. (auth)

3938 (JINR-E4-4034) ON CORRECTIONS OF ORDER αZ TO MUON CAPTURE IN ^{12}C. Ozevich, Z.; Pikul'ski, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 9p. Dep.

The result of the calculation of the partial muon capture in $^{12}C + \mu^- \rightarrow {}^{12}B$ (g.s.) reactions, including all effects of the order αZ is given. These effects are shown to be for $C_p/C_A = 8$, a 10% correction in the capture rate and a +2% correction in comparison with the result of Morita and Fujii. (auth)

3939 (UCLA-10-P-18-8) DISTORTED WAVE CALCULATIONS FOR THE $^{12}C(p,2p)^{11}B$ REACTION. Technical Report No. P-82. Richie, K. E. (California Univ., Los Angeles. Dept. of Physics). May 1968. Contracts AT(11-1)-34; AT-(11-1)-Gen-10. 36p. Dep. CFSTI.

The distorted-wave theory predictions for the angular correlation of the two protons emitted in the $^{12}C(p,2p)^{11}B$ reaction were studied by systematically changing the parameters describing the interactions between the two protons and the residual nucleus. The predictions were compared with data selected from a $^{12}C(p,2p)^{11}B$ experiment at 45.5 MeV. Excellent agreement is obtained provided either the optical model potential is overestimated, or a larger p-state radius than determined in a previous (p,2p) analysis is used. (auth)

3940 (UCRL-50501) THRESHOLD-PHOTONEUTRON CROSS SECTIONS FOR LIGHT NUCLEI. Van Hemert, Rudy Lee (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 23, 1968. 84p. Dep. CFSTI.

Thesis.

A fast-response neutron detector built and tested at the Livermore linear electron accelerator has the following properties: a neutron-detection efficiency of 12.7 to 3.2% for neutron energies between 2.1 keV and 3.5 MeV, an intrinsic response time of less than 5 nsec, a low sensitivity to the gamma flash associated with the electron-beam burst (counting can begin less than 200 nsec after the beam burst), and a good background-rejection capability. The detector consists of ten ^{235}U disks (each 0.05 in. thick and 10 in. in dia) that are positioned inside a 24-in.-long cylindrical shell made from the plastic scintillator NE 102. The axes of the disks and the cylinder are co-linear. The collimated neutron beam passes through the hollow plastic cylinder along its axis and induces fission and capture events in the ^{235}U. These events are identified in the scintillator by detecting the resulting gamma rays or fast neutrons. The backgrounds are reduced with coincidence circuits. The fast-response neutron detector was used for threshold photoneutron measurements; and the differential cross sections at 135° for the isotopes ^{10}B, ^{24}Mg, ^{28}Si, ^{32}S, ^{40}Ca, ^{19}F, ^{25}Mg, ^{26}Mg, and ^{31}P were then obtained. The typical experimental energy resolution ranged from 0.3 MeV for neutrons having an energy of 3.4 MeV to 0.01 keV for neutrons having an energy of 2.31 keV. The proton energies ranged from 7.0 to 19.5 MeV. The measurements were made with bremsstrahlung endpoint energies ranging from threshold to several MeV above threshold. The backgrounds were determined from below-threshold measurements. The differential cross sections for ^{24}Mg, ^{25}Mg, and ^{26}Mg exhibited several well-resolved resonances, most of which have never been seen before. The differential photoneutron cross sections were plotted against the laboratory neutron energy for the nine isotopes and were normalized to within a maximum uncertainty of 31%. The self-conjugate nucleus ^{24}Mg was analyzed for dipole transitions where the spin and the isospin changed one quantum unit (i.e., where there were transitions of $\Delta J = 1$ and $\Delta T = 1$). Excitation levels in ^{24}Na were predicted on the basis of the excitation levels for the resonances observed in the analog nucleus ^{24}Mg. These levels in ^{24}Na were also related to resonances that should be observed in the reaction $^{23}Na(n,\gamma)^{24}Na$. The technique described is generally applicable for dipole transitions in self-conjugate nuclei. (auth)

3941 PARTICLE-CORE COUPLING IN ^{17}O. Birkholz, J.; Beck, F. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett., 28B: 18-21(Oct. 28, 1968).

Low-lying positive- and negative-parity states in ^{17}O, ^{17}F were calculated, taking core excitations into account. The general features of the excitation spectra were fairly well reproduced by inclusion of the rotational bands of positive and negative parity in ^{16}O. (auth)

3942 THE VECTOR ANALYZING POWER FOR (d,p) STRIPPING REACTIONS ON LIGHT AND INTERMEDIATE WEIGHT TARGET NUCLEI. Yule, Thomas Joseph. Madison, Wis., Univ. of Wisconsin, 1968. 169p.

Thesis.

Polarized deuterons were used to initiate a number of stripping reactions for which the orbital angular momentum, l, and the total angular momentum transfer, j, are known. The vector analyzing power, $P_d(\theta)$, which is proportional to the left-right asymmetry when deuterons with pure vector polarization are incident, was measured. Measurements were made at a deuteron energy of about 8 MeV for (d,p) reactions for which l = 0, 1, 2, or 3 on the target nuclei ^{9}Be, ^{12}C, ^{24}Mg, ^{40}Ca, and ^{52}Cr. For a given l, there is a pronounced difference at forward angles between $P_d(\theta)$ for $j = l + \frac{1}{2}$ and $j = l - \frac{1}{2}$ reactions. The most striking j-dependences were observed for l = 1 transitions for the ^{40}Ca and ^{52}Cr target nuclei. The measured vector analyzing powers are compared with predictions based on the distorted-wave Born approximation. Effects of variations of optical parameters, and of inclusion of spin-orbit coupling, and of contributions from the nuclear interior are discussed. It can be concluded that, if one uses optical potentials which fit the elastic-scattering data, the measured vector analyzing powers can be reproduced for intermediate weight target nuclei. (Disser. Abstr.)

3943 USE OF NONLOCAL FACTORIZABLE POTENTIAL TO CALCULATE THE SPECTRA OF A = 12 NUCLEI IN THE PARTICLE-HOLE EXCITATION APPROXIMATION. Vashakidze, I. Sh.; Eliava, A. T. Soobshch. Akad. Nauk Gruz. SSR, 51: 51-4 (July 1968). (In Russian).

The calculation of the spectra of light and intermediate nuclei directly from nucleon–nucleon interactions presents difficulties; the methods used include the determination of the one-particle level, followed by shell-model calculations. The method was found effective for nuclei with A = 4; therefore, an attempt was made to extend their application to nuclei with A = 12, including the isobaric nuclei ^{12}B, ^{12}C, and ^{12}N. The one-particle levels were calculated by the Tamm–Dancoff method, determining the energy of the particle–hole states by means of the random phase method. The calculated energies of the excited states are presented in tabular form. The results confirmed that the "true" nucleon–nucleon interactions yield self-consistent values when used to calculate the excited states of light nuclei. (TTT)

3944 THE MEASUREMENT AND DISTORTED-WAVE BORN-APPROXIMATION ANALYSES OF SOME 19-MeV (α,p) DIFFERENTIAL CROSS SECTIONS FOR ^{14}N, ^{31}P, AND ^{32}S. Deardorff, Donald Lewis. Lafayette, Ind., Purdue Univ., 1968. 103p.

Thesis.

The differential cross sections for the (α,p) reactions leading to the ground, 0.871-, 3.058-, and 3.846-MeV states of ^{17}O (E_α = 18.72 MeV); the ground, 2.13-, and 3.30-MeV states of ^{34}S(E_α = 18.72 MeV); and the ground, 1.220-, and 1.762-MeV states of ^{35}Cl(E_α = 19.18 MeV) were measured from approximately 10 to 170° at 5° intervals. The ^{14}N, ^{31}P, and one kind of ^{32}S targets were prepared by the thermal vacuum deposition of Melamine (various thicknesses from 200 to 900 $\mu g/cm^2$), red phosphorus (603 and 640 $\mu g/cm^2$), and antimony sulfide (440 $\mu g/cm^2$), respectively, onto thin (~15 $\mu g/cm^2$) Formvar films. The second kind of ^{32}S targets were fabricated from a lamination of several thin Formvar films which were produced from a solution containing dissolved elemental sulfur and had approximate thicknesses of 200 $\mu g/cm^2$. The proton spectra were measured using a spectrometer system which incorporated an (E,ΔE) counter telescope consisting of a thin silicon surface-barrier detector (ΔE), a Li-drifted silicon detector (E-ΔE), a simple particle identification system, and a multichannel pulse-height analyzer. Proton identification was accomplished by imposing appropriate differential limits on the ΔE pulse sizes and a lower limit on the (E-ΔE) pulse sizes. The angular distributions for the $^{14}N(\alpha,p_{0,1,2,3})^{17}O$ reactions are somewhat oscillatory and show backward-angle peaking, but no two are alike in over-all shape. The angular distributions for the ^{31}P $(\alpha,p_{0,1,2})^{34}S$ reactions all show forward-angle peaking, washed-out structures, and no backward-angle peaking. The angular distributions for the $^{32}S(\alpha,p_{0,1,2})^{35}Cl$ reactions show mild oscillatory behavior with a tendency toward backward-angle peaking, but are unique in over-all shape. Comparisons of these angular distributions are made with those corresponding to other energies. In some cases the angular distributions change shape rather rapidly in the energy range of the present investigations. The excitation functions for the $^{32}S(\alpha,p_{0,1,2})^{35}Cl$ reactions were measured at θ_{lab} = 170° over a limited energy range around 19.18 MeV. These measurements indicate that these excitation functions are strongly energy dependent in this energy region. It is concluded that all the reactions investigated may have non-negligible compound-nucleus contributions at alpha-particle energies of about 19 MeV. The experimental data from the $(\alpha,p_{0,1,2})$ reactions on ^{31}P and ^{32}S were analyzed in terms of simple DWBA zero-range knockout and stripping models in which the initial and final nuclear states are characterized as appropriate two-body bound systems. Several sets of entrance-channel optical-model parameters were investigated. For each nucleus, the set with the deepest real well (~105 MeV) gave the best reproduction of the data. The best fits were achieved through the use of a cutoff radius in calculating the radial integrals. However, in spite of the extensive parametrization offered by these formalisms, the data could only be marginally fitted. No attempts were made to analyze the experimental data from the $^{14}N(\alpha,p_{0,1,2,3})^{17}O$ reactions due to uncertainties in entrance- and exit-channel optical-model parameters. Based on the results of these analyses, it is concluded that the utility of these formalisms for the extraction of spectroscopic information from (α,p) reaction data in this mass and energy region is doubtful. (Disser. Abstr.)

3945 A DETERMINATION OF THE HALF-LIFE OF ^{14}C. Bella, F. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Alessio, M.; Fratelli, P. Nuovo Cim., 58B: 232-46 (Nov. 11, 1968).

The results of a measurement of the half-life of radiocarbon which has been made with the aim of reaching a precision sufficiently high to clarify the discrepancy between two previously reported average values are presented. The result obtained ($T_{\frac{1}{2}}$ = 5660 ± 30 years) seems to confirm that the actually accepted value is too small. (auth)

3946 INTEGRATED YIELD AND ENERGY DISTRIBUTION OF ALPHA PARTICLES AT 145° FROM ^{12}C DISINTEGRATED BY 17.5-MeV ELECTRONS. Ender, Traugott. University Park, N. Mex., New Mexico State Univ., 1968. 85p.

Thesis.

Electrodisintegration of ^{12}C into three alpha particles was observed with a silicon surface-barrier detector at 145° from the incident beam of 17.5-MeV electrons. The integrated cross section for the reaction is 4 ± 2 $\mu b \cdot MeV/sr$. The break-up of ^{12}C, which is caused by the interaction of electrons directly with the nucleus, proceeds primarily through the intermediate configuration $^{8}Be + \alpha$ to the final state 3α. This is the sequence which also dominates the disintegration of ^{12}C by photons. Interpretation of the experimental energy spectrum of alpha particles at 145° identifies 12 percent of the 241 events as the break-up $^{12}C^*(12.5) \rightarrow {}^{8}Be(0) + \alpha \rightarrow 3\alpha$. Another 18 percent of the nuclear reactions involve the sequence $^{12}C^*(11.83) \rightarrow {}^{8}Be(0) + \alpha \rightarrow 3\alpha$. Finally, about 69 percent of the total number of alpha particles observed are due to the excitation of $^{12}C^*(9.64)$, $^{12}C^*(10.1)$ and $^{12}C^*(10.84)$, and the break-up which proceeds through the intermediate state $^{8}Be(0) + \alpha$. Excitation of other levels of ^{12}C, and the break-up through other possible configurations into the state 3α, account for the remaining events observed. (Disser. Abstr.)

3947 QUASI-FREE SCATTERING OF 56-MeV α PARTICLES BY α-PARTICLE CLUSTERS IN ^{6}Li AND ^{7}Li. Pizzi, J. R.; Bouche, R.; Gaillard, M.; Gaillard, P.; Guichard, A.; Gusakow, M.; Leonhardt, J. L.; Ruhla, C. (Univ., Lyon). Phys., Lett., 28: 32-4(Oct. 28, 1968).

The $^{6}Li(\alpha,2\alpha)D$ and $^{7}Li(\alpha,2\alpha)T$ reactions were studied at an incident energy of 56 MeV. Coincidence spectra were obtained by two methods: angular correlations and energy sharing at a fixed angle. The results of the two methods are compared, and a PWBA interpretation is given. (auth)

3948 ISOBARIC SPIN OF THE FIRST THREE EXCITED STATES OF ^{18}F BY THE STUDY OF THE REACTIONS $^{18}O(p,n_{1,2,3})^{18}F$. Bergdolt, Anne-Marie; Bergdolt, Georges (Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. A and B, 267: 455-6(Aug. 12, 1968). (In French).

Isobaric spins of T = 1 for the 1.042-MeV level of ^{18}F and T = $\frac{3}{2}$ for the 11.52-MeV level of ^{18}F were confirmed by a study of the (p,n) reactions. From measurements of the excitation curves of the reactions $^{18}O(p,p_\gamma)^{18}O$ and $^{18}O(p,n_{1,2,3}\gamma)^{18}F$, the following reactions were detected. $^{18}O(p,p_1)^{18}O$ at a γ energy of 1.98 MeV, $^{18}O(p,n_1\gamma)^{18}F$ at a γ energy of 0.940 MeV, $^{18}O(p,n_2\gamma)^{18}F$ at a γ energy if 1.042 MeV, and $^{18}O(p,n_3\gamma)^{18}F$ at a γ energy of 1.082 MeV. (J.S.R.)

3949 THE $^{6}Li(p,n)^{6}Be$ AND $^{7}Li(p,n)^{7}Be$ REACTIONS AT INTERMEDIATE PROTON ENERGIES. Batty, C. J.; Bonner, B. E.; Friedman, E.; Tschalaer, C.; Williams, L. E. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys., A120: 297-20(1968).

The $^{6,7}Li(p,n)^{6,7}Be$ reactions were studied over the angular range $0° \leq \theta_{lab} \leq 60°$ at both E_p = 30 and 50 MeV. In the case of ^{6}Be, the ground state and two other states were observed at 1.63 ± 0.16 and 3.47 ± 0.30 MeV excitation, respectively. In ^{7}Be, in addition to well-known states, two previously unobserved levels were observed at 11.7 ± 0.2- and 12.8 ± 0.2-MeV excitation. The highest and previously unobserved ^{6}Be level is in good agreement with cluster-model calculations and some ^{6}He data, therefore a further T = 1 state in ^{6}Li is predicted. The angular distributions of the $^{6,7}Be_{g.s.}$ transitions were fairly well reproduced using a DWBA calculation with a microscopic interaction. A real macroscopic (t · T) potential successfully predicted the shape of the angular distribution for the $^{7}Be_{g.s.}$ transition at both energies, but an additional imaginary (t · T) component appeared to be required to give the correct cross-section magnitude at 30 MeV. (auth)

3950 INELASTIC ELECTRON SCATTERING FROM ^{9}Be: LEVELS BELOW 10 MeV. Clerc, H.-G.; Wetzel, K. J.; Spamer, E. (Technische Hochschule, Darmstadt, Ger.). Nucl. Phys., A120: 441-59(1968).

Spectra of electrons scattered from ^{9}Be were measured with 100- to 260-keV resolution for primary energies between 105 and 165°, and excitation energies up to 20 MeV. For levels at 1.78, 2.44, 3.04, 4.7 and 6.4 MeV, ground-state radiative widths and transition radii are given. Evidence is presented for a negative-parity level at 3 MeV (possibly $\frac{1}{2}^-$ with an M1 ground-state radiative width of 0.18 eV). (auth)

3951 ^{16}O ANALOGUE STATES IN THE $^{15}N(p,n)^{15}O$ REACTION. Barnett, A. R. (Nuclear Physics Lab., Oxford). Nucl. Phys., A120: 342-68(1968).

The excitation function for the total cross section of the $^{15}N(p,n)^{15}O$ reaction was measured in small energy steps from the threshold at 3.78 MeV to 12 MeV ($E_x(^{16}O)$ = 15.7 to 23.2 MeV) using protons from the tandem Van de Graaff at AERE Harwell. The target thickness was varied from 8 to 50 keV depending on the width of the structure. An activation technique was used, the positons from the decay of ^{15}O being detected by a plastic scintillator. The absolute total cross section was measured at 5.52, 5.68 and 5.75 MeV by counting in coincidence the annihilation quanta from the positon decay, and these values were used to normalize the relative total cross-section curve. About 18 resonances were observed ranging in width from 20 keV to 650 keV; half of them could be identified in energy and width as T = 1 analogues of known states in ^{16}N. Matching these analogues resulted in an isobaric mass difference ^{16}N-^{16}O of 12.83 ± 0.02 MeV. A summary of the currently available information on spin-parity values of these T = 1 states is given; few states have better than a probable assignment. (auth)

3952 POSSIBILITY OF INTERPRETATION OF THE $d + {}^{10}B$ REACTION AT 270 keV THROUGH FEYNMAN DIAGRAMS AND DISPERSION THEORY. Nalda, J. (Facultad de Ciencias, Valladolid, Spain); Casanova, J.; Marquez, L. An. Fis., 64: 159-62(May-June 1968). (In Spanish).

Alpha emission in deuteron-induced reactions on ^{10}B was investigated. A formulation of the reaction mechanism in terms of Feynman diagrams and dispersion theory is outlined. (D.C.W.)

3953 PROJECTED HARTREE–FOCK SPECTRA FROM A REALISTIC TWO-BODY INTERACTION. Gunye, M. R. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A120: 691-6(1968).

The projection method was used to obtain good angular momentum and good isospin states from the intrinsic Hartree-Fock states of the nuclei in the 2s-1d shell. An effective interaction derived from the Yale potential was employed in the calculations. The static magnetic moments were predicted correctly. The static quadrupole moments and the lifetimes of the nuclear states for electric quadrupole transitions are predicted correctly if an effective charge of 0.5 e is ascribed to the neutrons. The projected energy spectra in even-mass nuclei were very much compressed as compared to the experimental spectra. The agreement between the projected and the experimental spectra in odd-mass nuclei was fair. (auth)

3954 VELOCITY-DEPENDENT POTENTIALS IN THE SHELL MODEL OF ^{18}O AND ^{18}F. Ganas, P. S.; McKellar, B. H. J. (Univ. of Sydney). Nucl. Phys., A120: 545-54(1968).

The low-lying energy levels of ^{18}O and ^{18}F are calculated in the harmonic oscillator shell model taking Green's velocity-dependent N-N potential as the residual interaction. It is found that the shell-model matrix elements agree substantially with those calculated by Kuo and Brown from the unrenormalized Hamada-Johnston hard-core N-N potential. It is found furthermore that Green's parameters give rather unsatisfactory agreement with the experimental spectra. It is shown that somewhat improved agreements with experiment are possible by making appropriate parameter adjustments. (auth)

3955 CENTROIDS AND SUMS OF ONE-NUCLEON TRANSFER STRENGTHS FOR AN ^{16}O TARGET. Wong, S. S. M. (Univ. of Alberta, Edmonton). Nucl. Phys., A120: 625-44(1968).

The centroids and sums of one-nucleon transfer strengths for an ^{16}O target were calculated using self-consistent shell-model wave functions for the ^{16}O ground state. The positions of the centroids were found to be sensitive to the amount of particle-hole admixtures in the target, and some of the strengths leading to the opposite parity states should be large enough to be observed experimentally. (auth)

3956 ALPHA ENERGY DISTRIBUTION OF $^{7}Li(p,\alpha)^{4}He$ REACTION. Lee, Chul Chu; Ko, Youn Kyu; Kim, Do Kyong; Park, Kyong Man (Yonsei Univ., Seoul). J. Nucl. Sci. (Seoul), 8: Pt.1, 11-16(Aug. 1968).

The angular distribution of the energy of α particles from the reaction $^{7}Li(p,\alpha)^{4}He$ was measured at a proton bombarding energy of 130 keV. It was concluded that the reaction obeys nonrelativistic kinematics rules. (D.C.W.)

3957 ANALYSIS OF THE INELASTIC SCATTERING ^{12}C $(\alpha,\alpha')^{12}C$ IN TERMS OF THE THEORY OF DIRECT INTERAC-

TION AND DIFFRACTION SCATTERING. Garcia, A. (Facultad de Ciencias, Valencia). An. Fis., 64: 51-61(Jan.–Feb. 1968). (In Spanish).

The inelastic scattering angular distributions of 38-MeV α particles by ^{12}C were analyzed in terms of direct interaction and inelastic diffraction scattering theories. The interaction radii and the parameters representing the corresponding nuclear deformation are deduced from the comparison between the experimental and theoretical angular distributions. (auth)

3958 ELASTIC SCATTERING OF α PARTICLES BY OXYGEN AT 20.2 TO 23.4 MeV. Cervera, J. M.; Gracia, A.; Senent, F. (Facultad de Ciencias, Valencia). An. Fis., 64: 33–41(Jan.–Feb. 1968). (In Spanish).

The elastic scattering of α particles by oxygen was studied at seven different beam energies from 20.2 to 23.4 MeV. Differential cross sections were calculated within the angular interval from 10 to 170° (lab. system). The energy dependence of the backward-angle scattering is specially investigated. (auth)

3959 ELASTIC SCATTERING OF α PARTICLES BY FLUORINE AT 20 TO 23 MeV. Aguilar, J.; Pineda, C. Fernandez; de la Rubia, J. (Facultad de Ciencias, Madrid). An. Fis., 64: 93-7(Mar.–Apr. 1968). (In Spanish).

The elastic scattering angular distribution of alpha particles by ^{19}F was measured using the photographic plate technique at four different beam energies. The differential cross section at 23.31 MeV was compared with Rutherford scattering, and a value of 6.30 ± 0.40 Fermis is obtained for the interaction radius, using the diffraction formula for a strongly absorbing disc. The backward angle scattering is specially studied. (auth)

3960 ANALYZING POWER OF THE REACTION $^{6}Li(d,\alpha)^{4}He$ WITH VECTOR-POLARIZED DEUTERONS OF ENERGY 2.1 TO 10.9 MeV. Duerr, W.; Clausnitzer, G.; Fick, D.; Fleischmann, R.; Hofmann, H. M.; Kilian, K. (Univ., Erlangen, Ger.). Nucl. Phys., A120: 678-90(1968). (In German).

The reaction $^{6}Li(d,\alpha)^{4}He$ with polarized deuterons gives new information about the reaction mechanism and the T = 0 levels of ^{8}Be with even spin and parity. In addition, the reaction can be used as a polarization analyzer for polarized deuterons at energies below E_d = 3.5 MeV. Fortunately, at these energies, the differential cross section is rather high. (auth)

3961 TOTAL CROSS SECTION OF THE REACTION $^{16}O(d,n)^{17}F$. Marmier, P.; Gobbi, A.; Huber, A.; Matter, U. (Laboratoire de Physique Nucleaire, Zurich). Helv. Phys. Acta, 41: 1028-30(Oct. 20, 1968). (In French).

The total cross section was determined by activation between the reaction threshold and 12 MeV. The excitation curve obtained is given and shows only very little of the structure and decreases by a factor of 2 between 4 and 12 MeV. The results obtained with a resolution of 20 keV between 4.5 and 5.5 MeV show the structures resolved into finer fluctuations. (J.S.R.)

3962 OPTICAL MODEL ANALYSIS OF ELASTIC SCATTERING OF 100-MeV PROTONS FROM LIGHT NUCLEI. Li, T. Y.; Mark, S. K. (McGill Univ., Montreal). Can. J. Phys., 46: 2645-58(Dec. 1, 1968).

Elastic scattering cross sections for the interaction of 100-MeV protons with ^{6}Li, ^{7}Li, ^{9}Be, and ^{12}C were analyzed using the optical model. The experimental differential cross sections are reasonably reproduced. It was found that no average set of geometrical parameters can provide a quantitative fit to the experimental data for all of these light nuclei; they must be treated individually, with optimum optical potential parameters fluctuating from one nucleus to another. Other features revealed in this analysis include: the spin–orbit radius parameter is smaller than those of the real and imaginary parts of the potential, surface and volume absorption potentials give equally good fit to the experimental results, the radius parameters of the real and imaginary potentials differed from each other, and the radius parameter of the real part of the potential is larger than those used for heavy nuclei. (auth) (Canada)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 2562, 3782, 3872, 3891, 3935, 3940, 3942, 3944, 3953, 4047, 4052, 4054, 4064, 4075, and 4076.

3963 (BNL-tr-224) MEASUREMENT OF THE CROSS SECTIONS FOR NEUTRON CAPTURE BY RADIOACTIVE ^{58m}Co, ^{64}Cu, AND ^{46}Sc NUCLEI. Kondurov, I. A.; Egorov, A. I.; Kaminker, D. M.; Korotkin, E. M.; Nikitin, A. M. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from At. Energ. (USSR), 24: 533-40(1968). 19p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 44674.

3964 (ITEF-595) REACTIONS $^{58,60,62,64}Ni(d,n)^{59,61,63,65}Cu$ AND $^{64,66,68}Zn(d,n)^{65,67,69}Ga$. Okorokov, V. V.; Bochin, V. P.; Pomanov, V. S.; Serezhin, V. M.; Smotryaev, V. A.; Tolchenkov, D. L.; Trostin, I. S.; Cheblukov, Yu. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 31p. (In Russian). Dep.

The proton states of $^{59,61,63,65}Cu$ and $^{65,67,69}Ga$ were investigated in (d,n) reactions on $^{58,60,62,64}Ni$ and $^{64,66,68}Zn$. The neutron spectra were measured using time-of-flight method. The values lp and $(2j + 1)C^2S$ for resolved levels were calculated in the distorted-wave approximation. (auth)

3965 (ITEF-598) THE STRUCTURE OF THE PROTON STATES FOR NUCLEI $^{51\ 53\ 54\ 55}Mn$ AND $^{55\ 57\ 58}Co$. Okorokov, V. V.; Serezhin, V. M.; Smotryaev, V. A.; Tolchenkov, D. L.; Trostin, I. S.; Cheblukov, Yu. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 34p. (In Russian). Dep.

The proton states of the nuclei $^{51,53,54,55}Mn$ and $^{55,57,58}Co$ were investigated using (d,n) reactions. The neutron spectra were measured using the time-of-flight method. The values l_p and $(2j + 1)C^2S$ for the resolved levels were obtained from a distorted-wave calculation. The spectra from (d,n) and (d,p) reactions on nuclei with identical shell filling were compared. (auth)

3966 THE FINE STRUCTURE OF ISOBARIC ANALOGUE RESONANCES IN ^{43}Sc AND ^{45}Sc. Browne, J. C. (Duke Univ., Durham, N. C.); Keyworth, G. A.; Lindstrom, D. P.; Moses, J. D.; Newson, H. W.; Bilpuch, E. G.; Wilhjelm, P. Phys. Lett., 28B: 26-9(Oct. 28, 1968).

The isobaric analogues of the 10th and 19th excited states of ^{43}Ca and of the 6th excited state of ^{45}Ca were observed in (p,p) reactions on ^{42}Ca and ^{44}Ca. Spins, parities, and widths were extracted and were compared with the results from (d,p) stripping. (auth)

3967 ISOBARIC ANALOGUE RESONANCES IN PHOTOPROTON REACTIONS. Shoda, K.; Sugawara, M.; Saito, T.; Miyase, H. (Tohoku Univ., Sendai). Phys. Lett., 28B: 30-1 (Oct. 28, 1968).

Photoproton energy distributions from ^{89}Y, ^{90}Zr, ^{139}La, ^{140}Ce, and ^{141}Pr were measured. Strong proton peaks through isobaric states were found in the cases of ^{90}Zr and ^{140}Ce. In the other cases no prominent peaks were observed. (auth)

3968 $^{29}Si(d,p)^{30}Si$ REACTION AT E_d = 1 TO 2 MeV. Calvi, G.; Cavallaro, S.; Figuera, A. S.; Sandoli, M. (Univ., Catania, Italy. Centro Siciliano di Fisica Nucleare e Struttura della Materia, Catania, Italy). Nuovo Cim., 58B: 363-5(Nov. 11, 1968).

Angular distributions and excitation functions for proton groups from the reaction $^{29}Si(d,p)^{30}Si$ were measured at deuteron energies of 1 to 2 MeV in order to obtain information on the reaction mechanism. The results indicate that the statistical mechanism contributes significantly. (D.C.W.)

3969 ISOMERIC CROSS-SECTION RATIOS FOR REACTIONS PRODUCING THE ISOMERIC PAIRS ^{69}Zn AND ^{69m}Zn, ^{71}Zn, AND ^{71m}Zn. Demichelis, F.; Guidetti, M.; Miraldi, E.; Oldano, C. (Istituto di Fisica Sperimentale del Politecnico, Turin). Nuovo Cim., 58B: 177-90(Nov. 11, 1968).

Absolute cross sections and isomeric cross-section ratios were measured for the following reactions in which the ^{69}Zn and ^{69m}Zn, ^{71}Zn, and ^{71m}Zn isomeric pairs are produced: $^{69}Ga(n,p)$, $^{71}Ga(n,p)$, $^{72}Ge(n,\alpha)$, and $^{74}Ge(n,\alpha)$. These experimental values are interpreted in terms of the spin dependence of the nuclear level density. Isomeric ratios were compared with calculations based on different nuclear models. Calculations with a shifted Fermi gas model require a moment of inertia smaller than the rigid body; in general a reasonable fit is obtained with independent-pairing and superconductor models. (auth)

3970 MOESSBAUER EFFECT IN ^{40}K. Tseng, Poh-kun. Ann Arbor, Mich., Univ. of Michigan, 1968. 116p.

Thesis.

The Moessbauer effect for the 29.4-keV gamma ray from ^{40}K formed in the neutron capture reaction $^{39}K(n,\gamma)^{40}K$ was employed to determine the change in nuclear radius between the initial and final states of this γ-ray transition. A number of potassium compounds were used as targets, i.e., as γ-ray sources for Moessbauer

measurements. These measurements were made at liquid nitrogen temperature. The results show that the background and the recoilless fraction vary strongly from one case to another, the quadrupole splitting and isomer shifts are small if not zero, and the magnetic hyperfine splitting in the two antiferromagnetic perovskites investigated was not appreciable below their Curie temperatures. The recoilless fraction was measured as a function of temperature for a number of targets. By fitting the results to curves based on the Debye theory of solids, values for the Debye temperatures of these targets could be obtained. In order to arrive at a value of $\delta\langle r^2\rangle/\langle r^2\rangle$ for the ^{40}K nucleus, four careful center-shift measurements were carried out with K metal at 10°K and KF at 10, 55, and 80°K as targets and KCl at 80°K as absorber. Comparison of the results of these measurements with estimates of the thermal shifts based on determinations of the Debye temperatures of the different targets shows that the measured line shifts are mainly due to thermal shifts. It is felt, however, that the accuracy of the measurements is sufficient to place an upper limit $\delta\langle r^2\rangle/\langle r^2\rangle < 5 \times 10^{-4}$ for ^{40}K. (Disser. Abstr.)

3971 AN ANOMALOUS COUPLING $1/2^+$ STATE IN ^{73}Se. Murray, G. (Univ. of Manchester, Eng.); White, W. J. K.; Willmott, J. C.; Entwistle, R. F. Phys. Lett., 28B: 35-7(Oct. 28, 1968).

The existence of a 25.9 ± 0.3-keV E3 transition is reported in ^{73}Se with a half-life of 42 min. This together with measurements on the β decay of the ground state and isomeric state of this nucleus, implies that the spins of these states are $1/2^+$ and $1/2^-$, respectively. (auth)

3972 COMPREHENSIVE COMPARISON OF NUCLEIDIC MASS FORMULAS BASED ON DIFFERENT NUCLEAR MODELS. Wing, James (Argonne National Lab., Ill.). Nucl. Phys., A120: 369-86(1968).

The following quantities were calculated with the nucleidic masses of the semiempirical formulas recently developed by Kummel et al., Seeger, Zeldes et al., and Garvey and Kelson: alpha decay energies as a function of neutron number N; slopes and intercepts of isotone lines representing neutron-pair separation energies as a function of proton number Z; roughness parameter, defined as $E_\beta(Z,N+1) + E_\beta(Z-1,N) - E_{\beta\beta}(Z-1, N+1)$, where E_β and $E_{\beta\beta}$ are total and double β^- decay energies, respectively; steepness, minima, and separation distances of isobaric parabolas; and energies available for emission of delayed neutron and delayed proton from precursors. These calculated quantities show systematic and random deviations from the empirical data at various mass regions. The present comparison easily reveals the similarities and differences among the nucleidic mass formulae which are based on various nuclear models. A list of errors in the publication by Kummel et al. on their mass equation is included. (auth)

3973 NEUTRON ACTIVATION CROSS SECTIONS AT 14.4 MeV FOR Kr and Xe ISOTOPES. Kondaiah, E.; Ranakumar, N.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Nucl. Phys., A120: 337-41(1968).

Quinol-clathrates of Kr and Xe were used as solid target powders for neutron activation and cross sections for 16 (n,2n), 7 (n,p), and one (n,α) reactions at 14.4 ± 0.3 MeV were measured; of these, 23 cross sections are reported for the first time. (auth)

3974 THERMAL NEUTRON ACTIVATION CROSS SECTIONS FOR Kr AND Xe ISOTOPES. Kondaiah, E.; Ranakumar, N.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Nucl. Phys., A120: 329-36(1968).

Quinol-clathrates of Kr and Xe were used as solid targets for neutron activation for the first time, and 16 (n,γ) cross sections were determined with thermal neutrons. The epithermal neutron contribution was taken into account by irradiating Cd covered samples. Four isomer cross-section ratios for Xe isotopes and one for Kr were also obtained. In the case of Xe isotopes, the spin cut-off parameters were evaluated from the isomer ratios. (auth)

3975 DEUTERON STRIPPING ON THE EVEN ISOTOPES OF Ca. I. Belote, T. A.; Dorenbusch, W. E.; Rapaport, J. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys., A120: 401-20(1968).

Deuteron-stripping reactions on a special target consisting of approximately equal amounts of the five stable even calcium isotopes were performed at 7.00 and 7.20 MeV. Angular distributions for the $l_n = 3$ $1f_{7/2}$ ground states and strongest $2p_{3/2}$ transitions were measured and analyzed using the DWBA. Optical-model parameters for the analysis were obtained from 7.00 and 7.20 MeV elastic-scattering measurements. Transitions to the 2.017 MeV level of ^{41}Ca and 0.990 MeV level of ^{43}Ca both with $l_n = 2$ were also obtained. Spectroscopic factors were deduced from the data and are discussed in terms of core excitation of the Ca ground-state target nuclei. (auth)

3976 DEUTERON STRIPPING ON EVEN ISOTOPES OF Ca. II. Andersen, S. A.; Hansen, Ole (Univ. of Copenhagen). Nucl. Phys., A120: 421-33(1968).

Angular distributions of ^{40,42,44,46,48}Ca(d,p) reactions were measured at 9.99 MeV bombarding energy, using a multiangle spectrograph and a target containing all of the stable even Ca isotopes in a known mixture. Transitions to the odd-A ground states and to the strong $2p_{3/2}$ levels were analyzed. Relative cross sections were obtained for these transitions to about 7% accuracy, and absolute cross sections to about 15% accuracy. Q-value differences were measured to about ±2 keV accuracy. A distorted wave analysis is presented and relative spectroscopic strengths are derived to an accuracy of about 10%. The ground state transition strengths deviate from the 8:6:4:2 ratios expected for pure $1f_{7/2}$ configurations. The ^{47}Ca and ^{49}Ca ground state strengths are, within experimental uncertainties, in the pure configuration ratio of 2:4. (auth)

3977 INVESTIGATION OF THE ^{27}Al(p,α_0)^{24}Mg REACTION AT PROTON ENERGIES 1180 TO 1920 keV. Bister, M.; Luukko, A.; Anttila, A. (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 285, 1-16(1968).

The yield curve of the ^{27}Al(p,α_0)^{24}Mg reaction was measured at proton energies of 1180 to 1920 keV with simultaneous recording of the ^{27}Al(p,γ)^{28}Si reaction. Thirteen (p,α_0) resonances were observed. The resonance energies and strengths are reported. The number of (p,γ) resonances observed were 25. In 12 cases the angular distributions of α_0 particles were measured. Formation and population parameters were determined from the distribution data. Theoretical coefficients for the calculation of Legendre polynomial coefficients, using population parameters, were tabulated for the case $J_f = 0^+$. (auth)

3978 STUDY OF THE NUCLEAR STRUCTURE OF ^{46}Ti BY THE ^{45}Sc(^{3}He,d) REACTION. Ohmura, Haruko; Ishimatsu, Toshiyuki; Yagi, Kohsuke; Ejiri, Hiroyasu; Nakajima, Yutaka; Tohei, Tsutomu; Nakagawa, Takemi (Tokyo Univ.). J. Phys. Soc. Jap., 25: 953-64(Oct. 1968).

The level structure of ^{46}Ti was studied by means of the ^{45}Sc(^{3}He, d)^{46}Ti reaction with 24.3-MeV ^{3}He particles. Thirty-eight deuteron groups were observed with a broad-range magnetic spectrograph up to an excitation of 8.5 MeV in ^{46}Ti. Angular distributions were measured and were compared with distorted-wave calculations to obtain values of the orbital angular momentum transfer and spectroscopic information. For most of the angular distributions there is considerable mixing from shells other than $1f_{7/2}$. Energies and spectroscopic factors of low-lying levels are compared with those calculated with the pure $(1f_{7/2})^6$ configuration model. Comparison with ^{50}Cr, a cross-conjugate nucleus of ^{46}Ti, is also made. (auth)

3979 PROTONS FROM ^{64}Zn AND ^{66}Zn BOMBARDED WITH 14.1-MeV NEUTRONS. Iwatani, Kazuo; Fujita, Iwao; Sonoda, Masateru; Katase, Akira; Wakuta, Yoshihisa (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap., 25: 964-70(Oct. 1968).

Energy spectra and angular distributions were measured for protons emitted from ^{64}Zn and ^{66}Zn bombarded with 14.1-MeV neutrons. Any of the level density formulas fits equally well the energy spectrum for backward angles. The constant temperature formula gives 1.22 ± 0.07 MeV and 1.35 ± 0.05 MeV as the nuclear temperatures of ^{64}Cu and ^{66}Cu, respectively. Using the Lang level density formula, the level density parameters for ^{64}Cu and ^{66}Cu are given as 8.26 ± 0.78 MeV^{-1} and 5.39 ± 0.56 MeV^{-1}, respectively. The proton angular distributions are concave and symmetric around 90°. The anisotropy is greater for higher-energy protons. The anisotropy of lower-energy protons emitted through the (n,p) reaction is found to be comparable to the anisotropy of those emitted through the (n,np) reaction. The cross sections for the (n,p) and (n,np) reactions for ^{64}Zn through the compound process are 127 ± 9 mb and 169 ± 26 mb and those for ^{66}Zn 30.0 ± 1.1 mb and 40.5 ± 8.3 mb, respectively. The direct (n,p) reaction for ^{64}Zn has a cross section of about 5 mb. (auth)

3980 ^{40}Ca–^{40}Ar MASS DIFFERENCE MEASUREMENT BY HIGH-RESOLUTION MASS SPECTROMETER. Fukumoto, Sadayoshi; Matsuo, Takekiyo; Matsuda, Hisashi (Osaka Univ.). J. Phys. Soc. Jap., 25: 946-50(Oct. 1968).

The atomic mass difference of ^{40}Ca and ^{40}Ar atoms was measured directly by the high-resolution mass spectrometer of Osaka University operating at a resolving power of 700,000 ~ 1,000,000. The result obtained is 208.2 ± 0.5 μu, somewhat larger than the value based on the 1964 atomic mass table. (auth)

3981 THE HALF-LIVES OF ^{56}Mn AND ^{198}Au. Goodier, I. W. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop., 19: 823(Nov. 1968).

The half-lives of ^{56}Mn and ^{198}Au, purified by chemical processing, were measured by following their decay in a high-pressure 4π ionization chamber for at least seven half-lives. Values of 2.578 ± 0.008 hr and 2.695 ± 0.007 days were obtained for ^{56}Mn and ^{198}Au, respectively. (D.C.W.)

3982 PROXIMITY SCATTERING IN THE SEQUENTIAL DECAY ^{40}Ca(d,n)^{41}Sc* $_{\gamma\text{-}\epsilon}$(p)^{40}Ca. Lassen, L. (Univ., Heidelberg); Zahradnik, W.; Zeitnitz, B. Nucl. Phys., A120: 645-56(1968).

In a nuclear two-stage reaction proceeding through excited states of an unstable intermediate system, rescattering can occur between two of the three outgoing particles as a special type of final-state interaction (proximity scattering). The probability for proximity scattering increases with a decreasing lifetime of the intermediate state. Correlations between protons and neutrons from the reaction ^{40}Ca(d,np)^{40}Ca were measured at a bombarding energy of 5.80 MeV and a neutron emission angle of 70°. The results were compared with a quantal calculation of the cross section for this process. A width Γ = 50 ± 20 keV for the excited state at 3.46 MeV in ^{41}Sc was deduced from this comparison. Apparent discrepancies between the Γ-values obtained by this method and by a classical prediction for the proximity scattering probability are discussed. (auth) (auth)

3983 A NEW MEASUREMENT OF THE HALF-LIFE OF THE ^{72}Ge 0^+ STATE. Eichler, E.; Stelson, P. H.; Dickens, J. K. (Oak Ridge National Lab., Tenn.). Nucl. Phys., A120: 622-4 (1968).

With a Ge(Li) detector as the target, the half-life of the 0^+ first excited state of ^{72}Ge was remeasured. A value of 422 ± 13 ns was obtained. (auth)

3984 THE g-FACTOR OF THE 320-keV STATE OF ^{51}V MEASURED BY COULOMB EXCITATION IN Fe–V ALLOY. Keszthelyi, L.; Demeter, I.; Szoekefalvi-Nagy, Z.; Varga, L.; Zamori, Z. (Central Research Inst. for Physics, Budapest). Nucl. Phys., A120: 540-4(1968).

The g-factor of the 320-keV first excited state of ^{51}V, measured by Coulomb excitation in Fe-V alloy, was found to be g = 1.54 ± 0.13. (auth)

3985 STUDY OF THE ^{32}S LEVELS AND THE ANALOGUE LEVELS OF ^{32}P BY THE ^{31}P(^{3}He,d)^{32}S REACTION. Graue, A. (Univ. of Bergen); Herland, L.; Lien, J. R.; Cosman, E. R. Nucl. Phys., A120: 513-29(1968).

The ^{31}P(^{3}He,d)^{32}S reaction was studied with high resolution at 12-MeV bombarding energy. A detailed level scheme for ^{32}S was determined up to an excitation energy of 9.5 MeV revealing several previously unobserved states. The l_p values and absolute spectroscopic factors extracted from a DWBA analysis of the experimental deuteron angular distributions provided information on the wave functions for the T = 0 states as well as for the T = 1 isobaric analogue states of ^{32}P. A comparison between the present data and those of previous experiments is made, and the results are discussed in terms of existing theoretical work in this mass region. Information on Coulomb displacement and symmetry energies is also extracted. (auth)

3986 ANGULAR DISTRIBUTIONS OF RECOIL PRODUCTS FROM SOME REACTIONS INDUCED IN ^{65}Cu AND ^{197}Au BY PROTONS OF ENERGY 30 TO 85 MeV. Dewanjee, M. K.; Saha, G. B.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 46: 3551-64(Nov. 15, 1968).

Angular distributions of products formed in the reactions ^{65}Cu(p,pn)^{64}Cu, ^{197}Au(p,pn)^{196}Au, and ^{197}Au(p,p3n)^{194}Au in the range of proton energy 30 to 85 MeV were studied. The angular distribution results of ^{64}Cu and ^{196}Au show forward peaking at low energy and sidewise peaking at higher energies. Approximate symmetry about 90° was observed for the angular distribution of ^{194}Au in the center-of-mass system. The experimental results have been compared with Monte Carlo evaporation calculations, cascade-evaporation calculations at 85 MeV for ^{64}Cu and, inelastic scattering plus evaporation calculations. Good agreement was obtained with statistical theory calculations at low energy and inelastic scattering model calculations at higher energies. The comparisons indicate that the reactions proceed by the compound-nucleus mechanism at lower energies and the direct interaction mechanism predominates at higher energies. (auth) (CANADA)

3987 DECAY CHARACTERISTICS OF ^{84}Se. Rengan, K.; Griffin, Henry C. (Univ. of Michigan, Ann Arbor). J. Inorg. Nucl. Chem., 30: 2887-90(Nov. 1968).

^{84}Se was identified among the fission products of ^{235}U. The Sc fraction was obtained by solvent extraction from HBr into 2,6-dimethyl-4-heptanone. The radiations were studied by β- and γ-ray scintillation spectroscopy, by γ-ray spectroscopy with a Ge(Li) detector, and by coincidence measurements. The decay of ^{84}Se shows a half-life of 3.1 ± 0.2 min and involves a single β transition of 1.4 ± 0.05 MeV and a coincident γ ray of 407.7 ± 0.5 keV. (auth) (UK)

3988 ANISOTROPY OF FAST PHOTONEUTRONS FROM CHROMIUM. McNeill, K. G.; Hewitt, J. S.; Jury, J. W. (Univ. of Toronto). Can. J. Phys., 46: 1974-8(Sept. 1, 1968).

The anisotropy of fast (>5 MeV) photoneutrons from chromium and lead was measured as a function of bremsstrahlung energy in the region 22 to 32 MeV. In the case of chromium, the anisotropy increases with energy. A possible explanation for this is advanced, and the implications of this explanation are compared with results from other nuclei. (auth)

3989 NEW GAMMA RAYS OF ^{77}As. Ardisson, Gerard; Forest, Hugues; Ythier, Christian (Faculte des Sciences, Nice). Compt. Rend., Ser. A and B, 267: 344-7(July 29, 1968). (In French).

Previously unobserved γ rays of 62.2, 82.0, 139.2, 200.6, and 439.7 keV in the decay of ^{77}As were interpreted as feeding or de-exciting a 439.7-keV level and probably a 301.3-keV level of ^{77}Se. (tr-auth)

3990 FRAGMENTATION OF HEAVY NUCLEI (Ag AND Br) IN EMULSIONS BY PROTONS AT 13,8 GeV/c. I. IDENTIFICATION OF EMITTED PARTICLES. Gil, D.; Senent, F.; Tarrega, P.; Villar, E. (Facultad de Ciencias, Valencia). An. Fis., 64: 43-9(Jan.-Feb. 1968). (In Spanish).

In order to throw new light on the problem of nuclear fragmentation and nuclear structure we have made a general study of the interactions of 13.8 GeV/c protons with heavy emulsion nuclei (Ag, Br). The method used in the identification of the emitted fragments, which is based on track-width measurements and the relations between the track-width and the dip and depth of the track in the emulsion, is explained. (auth)

3991 FRAGMENTATION OF HEAVY NUCLEI (Ag AND Br) IN EMULSIONS BY PROTONS AT 13,8 GeV/c. II. RESULTS. Doporto, M. P.; Gil, D.; Senent, F.; Tarrega, P.; Tejerina, A.; Villar, E. (Facultad de Ciencias, Valencia). An. Fis., 64: 163-75(May-June 1968). (In Spanish).

A separation of the fragments emitted in high-energy interactions, based on phenomenological reasons, is used. These reasons are given in detail, and two groups of fragments are found which are independent of the charge, the consequences are discussed. (auth)

3992 TOTAL EFFECTIVE CROSS SECTION OF Cr AND As FOR NEUTRONS OF 3 TO 5 MeV. Manero, F. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 161-3(May-June 1967). (In Spanish).

The neutron total cross sections of Cr and As were measured for neutrons of energies between 3.2 and 5.2 MeV. Neutrons of about ±30-keV energy spread were produced by bombarding a heavy ice target with deuterons. Both cross-section curves show broad resonances that suggest fluctuations in the level density of the compound nucleus. (auth)

3993 EXCITED STATES OF ^{52}Cr. Monahan, C. F.; Lawley, N.; Lewis, C. W.; Main, I. G.; Thomas, M. F.; Twin, P. J. (Univ. of Liverpool). Nucl. Phys., A120: 460-80(1968).

Excited states of ^{52}Cr were studied through p–γ coincidence measurements with a Ge(Li) detector, precise γ-ray energy measurements, and p–γ angular correlations. A multi-crystal system for angular correlation measurements is described. Precise excitation energies were obtained for ten levels. The 3.41 MeV level was assigned spin 3 or 4. The 3.47-MeV level was shown to be a doublet of separation 3.0 ± 1.1 keV; its lower member was assigned spin 3 or 5 and the upper member spin 2. Previous spin assignments were confirmed for several other levels. Multipole mixing ratios were measured for transitions from the three levels at 3.41 and 3.47 MeV and for transitions to the first excited state from the 2.97-, 3.16-, and 3.77-MeV levels. Branching ratios were measured for the 3.16- and 3.77-MeV levels. (auth)

3994 PRODUCTION OF ^{69m}Zn IN THE OAK RIDGE RESEARCH REACTOR. Hupf, H. B. (Oak Ridge National Lab., Tenn.). Int. J. Appl. Radiat. Isotop., 19: 853-7(Dec. 1968).

Production of ^{69m}Zn in the Oak Ridge Research Reactor by two nuclear reactions was studied using natural abundance Ga_2O_3 and isotopically enriched Ga_2O_3 and ZnO. The fission-neutron cross section for the ^{69}Ga(n,p)^{69m}Zn reaction was determined to be 0.496 ± 0.073 mb. Separation of the zinc products from gallium target was achieved by solvent extraction. Production of ^{69m}Zn by the ^{68}Zn(n,γ)^{69m}Zn reaction produced an average isotopic abundance of 2.22 mCi of ^{69m}Zn per mg of zinc target. (auth) (UK)

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Refer also to abstracts 3284, 3891, 3906, 3967, 3972–3974, 3981, 3990, 3991, 4042, 4049, 4052, 4054, 4058, and 4070.

3995 (BLG–421) AN EVALUATION OF NUCLEAR DATA FOR SOME ACTIVATION DETECTORS USEFUL IN THERMAL AND EPITHERMAL SPECTRAL INDICES MEASUREMENTS. Damle, P. P.; Fabry, A.; Van Den Broeck, H. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). [1966]. 38p. Dep.

A critical survey of literature up to August 1967 allows presentation of recommended values of the thermal cross section, resonance integral, and resonance parameters for the reactions $^{164}Dy(n,\gamma)^{165g}Dy$, $^{151}Eu(n,\gamma)^{152m}Eu$, $^{176}Lu(n,\gamma)^{177g}Lu$, $^{191}Ir(n,\gamma)^{192g}Ir$, $^{193}Ir(n,\gamma)^{194g}Ir$, $^{115}In(n,\gamma)^{116m}In$, $^{197}Au(n,\gamma)^{198}Au$, $^{175}Lu(n,\gamma)^{176m}Lu$, and $^{186}W(n,\gamma)^{187}W$, in relation to their application to the spectral index technique at energies below 20 eV. A table with these best data is given for each reaction; extensive comments are included. (auth)

3996 (CONF-670653–1) NEUTRON RESONANCE STRUCTURE OF ^{164}Er AND PARAMAGNETIC SCATTERING OF ^{168}Er. Mughabghab, S. F.; Chrien, R. E.; Bhat, M. R. (Brookhaven National Lab., Upton, N. Y.). [nd]. 13p. Dep. CFSTI.

From Joint Meeting of the American Physical Society and the Canadian Association of Physicists, Toronto, Ontario.

Resonance parameters for ^{164}Er from 7.9 to 225.2 eV were extracted from transmission data obtained with the fast chopper facility at the BNL Graphite Reactor. Average level spacings were determined for ^{164}Er and ^{167}Er. Transmission data on ^{168}Er yielded a value of 33.6 ± 2.0 b for the total cross section of ^{168}Er at 0.025 eV. A paramagnetic scattering cross section of 26.1 ± 2.5 b was extracted from the total cross section of ^{168}Er. (D.C.W.)

3997 (JINR–P1–4051) MECHANISM OF THE ^{239}Pu FISSION BY MUONS. Butse, A.; Voikulesku, G.; Grama, N.; Dorchoman, D.; Marinesku, L.; Omel'yanenko, M.; Petrashku, M.; Khulubei, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 12p. (In Russian). Dep.

The probability ratio of the nonradiative and ordinary fission in μ-mesic atoms of ^{239}Pu nuclei was measured with a gas scintillation counter and using two-dimensional analysis. It is supposed that the probability of the nonradiative fission mechanism is connected with the measurement effect of the fission barrier under the influence of the μ-mesons, which was predicted by Zaretsky et al. (auth)

3998 (JINR–P7–4024) CHARGE AND ISOTOPE DISTRIBUTIONS OF THE EXCITED NUCLEUS FRAGMENTS IN THE HIGH ION REACTIONS. Karamyan, S. A.; Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Pustyl'nik, B. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 33p. (In Russian). Dep.

Charge and isotope distributions of fragments were measured while fissioning ^{238}U with ^{12}C, ^{20}Ne, and ^{40}Ar ions. It was found that the charge dispersion of fission fragments σ_z^2 at the given mass increases strongly with the increasing parameter Z/A of the fissioning excited nucleus at $Z^2/A > 38$. It was also found that the fragment charge fluctuation decreases with the increasing parameter of separation (A_1/A_2). It is shown that the value σ_z^2 is a weak function of the excitation energy of the initial nucleus. The experimental results are in disagreement with the predictions of the statistical theory of nuclear fission. (auth)

3999 (JINR–E7–4071) NUCLEON AND NUCLEON GROUP TRANSFER REACTIONS INDUCED IN THE BOMBARDMENT OF ^{197}Au AND ^{232}Th BY ^{12}C, ^{14}N, ^{15}N PROJECTILES. Volkov, V. V.; Gridnev, G. F.; Zorin, G. N.; Chelnokov, L. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 29p. Dep.

Gold-197 and ^{232}Th targets were bombarded by ^{12}C, ^{14}N, ^{15}N, projectiles at energies of 82, 110, and 98.5 MeV, respectively. Differential cross sections and energy spectra were measured for the transfer of one proton, one neutron, a deuteron, ^3He, and ^4He. The angular distributions of all transfer reactions have a peak at the angle, corresponding to the Rutherford scattering of two nuclei by grazing collision. The cross section of the few-nucleon transfer differs only slightly from that of the single-nucleon transfer. The energy spectra of the ^3He transfer turned out narrower than those of the proton transfer. These results indicate the possibility of the cluster level excitation by the few-nucleon transfer. The ^4He pick-up cross section was smaller than some microbarns; it is possible that the alpha particle is picked up by the unbound levels of the projectiles. (auth)

4000 (NP-tr–1707) PRECISE MEASUREMENT, IN THE SYMMETRIC MASS REGION, OF THE KINETIC ENERGY OF FRAGMENTS OF THERMAL FISSION OF ^{235}U. Signarbieux, C.; Ribrag, M.; Nifenecker, H. Translated by A. E. Lewis (Atomic Energy Research Establishment, Harwell, Eng.), from Nucl. Phys., A99: 41–54(1967). 18p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 29977.

4001 (ORNL–TM–2339) THE $^{117,119}Sn(p,n)^{117,119}Sb$ REACTIONS NEAR 0^+ ANALOGUE STATES. Kernell, Robert Lee (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 119p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The $^{117,119}Sn(p,n)^{117,119}Sb$ reactions were investigated in the vicinity ($E_p \approx 4.5$ MeV) of the 0^+ analogue states in the compound nuclei $^{118,120}Sb$ in order to make spin-parity assignments to low-lying states in the residual nuclei. Relative differential cross sections were measured by using the time-of-flight technique in conjunction with a pulsed proton beam from a 5.5-MeV Van de Graaff accelerator. Signals produced by protons incident on a liquid scintillator were processed by instrumentation which discriminated against gamma rays and also reduced the effect of electronic "walk." The system had a resolution of 15 keV at a neutron energy of 2 MeV. Absolute total (p,n) cross sections were measured to an accuracy of ±5% by using BF_3 counters to detect neutrons which had diffused through a graphite moderator. Angular distributions and 30° and 90° excitation functions were measured for the $^{117}Sn(p,n)^{117}Sb$ reaction. The degree of the on-resonance enhancement of neutron yields to states of known spin and parity was determined by investigating the four lowest known states of ^{117}Sb. By using these known enhancements as guidelines, spin-parity assignments were made to several additional ^{117}Sb levels on the basis of their observed enhanced yields. The observed level energies (in keV) and their I^π assignments (with tentative values enclosed in parentheses) are: 0: $5/2^+$; 530: $(7/2)$; 720: $1/2^+$; 925: $3/2^+$; 1085: $(7/2, 9/2)$; 1165: $I \geq 7/2$; 1300: $I \geq 7/2$; and 1355: $(1/2)^-$. No assignments were made to states observed at 1.38, 1.42, and 1.46 MeV. On- and off-resonance differential yields were measured at 90° for the $^{119}Sn(p,n)^{119}Sb$ reaction. An indication of the anisotropy of the angular distributions was determined by measuring a 30° spectrum off resonance. On the basis of the on-resonance enhancement of the neutron yields, considered in conjunction with the anisotropies and the relative differential cross sections off resonance, the observed levels (with energies in keV) are given the following I^π assignments (with tentative values in parentheses): 0: $(5/2^+)$; 271: $(7/2)$; 644: $1/2^+$; 700: $3/2^+$; 975: $(9/2)$; 1046: $(7/2)$; 1240: $I \geq 7/2$; 1337: $(1/2)^-$; 1416: $3/2^-$; 1482: $1/2^-$; 1547: $(7/2)$; 1665 doublet: $(1/2^+)$ and $(3/2^+, 5/2^+)$; 1745: $3/2^+$; 1822: $1/2^+$; 1880 doublet: $(9/2^+)$ and $(5/2^-, 7/2)$; 1970: $(9/2)$; 2130 doublet: $(1/2^+)$ and $(3/2^+, 5/2^+)$. No assignment is given to levels observed at 2225 and 2275 keV. The observed enhanced yields were used to determine relative values for $s_{1/2}$, $p_{1/2}$, $p_{3/2}$, $d_{3/2}$, and $d_{5/2}$ neutron strength functions. The experimental values indicate that spin–orbit coupling is strong for d-wave neutrons and very weak for p-wave neutrons. The total (p,n) cross sections measured with the graphite sphere detector exhibit highly symmetrical analogue resonances which are well fitted by Lorentzian curves having a width of 30 keV. The $^{117,119}Sb$ levels excited via the (p,n) reaction are compared to results from beta decay and $(^3He,d)$ studies. The states with positive parity have spacings which are consistent with the particle-core coupling model in which the odd proton in a $d_{5/2}$ or $g_{7/2}$ single particle orbital is coupled to the ground or one-phonon 2^+ state of the even–even core (^{116}Sn or ^{118}Sn). No low-spin negative parity states of $^{117,119}Sb$ have been reported previously. It is suggested that the $1/2^-$ and $3/2^-$ levels observed are due to particle-core coupling involving the 3^- octupole core levels. (auth)

4002 (RT/FI–(68)20) NUMERICAL SIMULATION OF THE γ DECAY OF A NUCLEUS FROM AN EXCITED STATE. Giacobbe, P.; Stefanon, M.; Dellacasa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 22p. Dep.

A numerical simulation of γ cascades following resonance capture of neutron by medium-weight or heavy nuclei was developed. The decay of levels in ^{178}Hf, excited by resonance neutron capture in ^{177}Hf, was analyzed, and the results were compared with experimental data. (J.W.R.)

4003 (UCRL–18313) CHARGE AND ENERGY DISTRIBUTION OF RECOIL ATOMS FROM THE ALPHA DECAY OF ^{226}Th. Gunter, Karlene Corbit Klages (California Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1968. 203p. Dep. CFSTI.

Thesis.

The charge and energy distribution of ^{226}Th recoils from thin,

electrostatically collected recoil sources were studied with a 180° double-focusing alpha spectrograph. It was determined that the energy distributions so obtained were the result of collisions between the recoils and atoms on or in the source plate. The charge distribution of the recoils associated with $^{226}Th\alpha_0$ peaked at a charge of +1 whereas those associated with the electron conversion process following the emission of a $^{226}Th\alpha_{111}$ peaked at a charge of +11. These charge distributions are likely not too different from those which would be obtained from the decay of gaseous ^{226}Th. In order to insure that the recoils sources used for the above study were thin, a series of experiments were carried out to determine the best method of preparing consistently thin alpha sources. Three techniques were investigated: vacuum sublimation, electrostatic parallel plate collection and cylindrical electrostatic collection on a thin edge. Of these three, parallel plate collection produced the thinnest sources by far. The best such plates were made by collecting recoils in air at STP onto clean Pt employing the smallest possible source-collector separation and the minimum electric field intensity needed for total collection. In connection with this work, more accurate values were obtained for the intensities of the various alpha groups of ^{226}Th than are presently in use. The intensity of the 111.1-keV γ ray was also obtained along with evidence that the present level assignments for the third and fourth excited states of ^{222}Ra are correct. (auth)

4004 (WAPD-TM-772) AN EVALUATION OF ETA FOR ^{233}U AT 0.025 eV USING THE RECAP-4C MONTE CARLO PROGRAM (LWBR DEVELOPMENT PROGRAM). Emert, C. J.; Milani, S.; Candelore, N. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Sept. 1968. Contract AT-11-1-GEN-14. 15p. Dep. CFSTI.

With few exceptions the values of $\bar{\nu}$ for the fissile isotopes have been measured relative to the value of $\bar{\nu}$ for ^{252}Cf. However, an examination of the reported values of $\bar{\nu}$ for ^{252}Cf reveals a considerably greater spread in magnitude than is suggested by the accuracies of the individual measurements. The recommended values of $\bar{\nu}$ have been derived with heavy reliance upon η and α measurements. Because of the importance of eta, an analysis was performed of an experiment that measured the value of η for ^{233}U, ^{235}U, and ^{239}Pu. The results of an analysis of a monoenergetic 0.025-eV measurement of eta for ^{233}U using the recently developed RECAP-4C Monte Carlo program are presented. This analysis lends additional support to the eta value of 2.298 at 0.025 eV and indirectly to the value of $\bar{\nu}$ based upon this value of eta. (auth)

4005 THE MEASUREMENT OF NUCLEAR GYROMAGNETIC RATIOS OF SHORT-LIVED STATES USING INTERNAL FIELDS. Bowman, James David. Pasadena, Calif., California Inst. of Tech., 1968. 81p.

Thesis.

The nuclear gyromagnetic ratios of the first excited 2^+ states in ^{114}Cd, ^{122}Te, and ^{124}Te were measured to be 0.42 ± 0.06, 0.31 ± 0.03 and 0.22 ± 0.05 μ_N, respectively. The perturbed gamma-gamma angular correlation method was used. The large experimentally known hyperfine fields present at the positions of the nuclei of substitutional impurity atoms in an iron lattice were used to obtain mean angles of precession large enough to be measured. The experimental results are compared with theory, and with the results of Coulomb excitation implantation measurements. In each instance the agreement is poor. (Disser. Abstr.)

4006 ONE-NEUTRON TRANSFER REACTIONS ON TIN NUCLEI AND HIGHER QUASI PARTICLE TAMM–DANCOFF MICROSCOPIC THEORIES. Alzetta, R. (Univ., Trieste, Italy). Nuovo Cim., 58B: 323-38(Nov. 11, 1968).

The spectroscopic factors for stripping and pick-up reactions on the tin isotopes are calculated with the nuclear wave functions of microscopic theories of the one- and three-quasiparticle Tamm–Dancoff (QTD 13) and of the quasiparticle second Tamm–Dancoff (QSTD) methods, which describe the states of the odd-mass and even-mass isotopes, respectively. The residual two-body nuclear force is the Gaussian Wigner force of Kuo et al. The results are compared both with experiment and with the previous results of Kuo et al., where the nuclear wave functions of the even isotopes are approximated by the quasiparticle Tamm–Dancoff (QTD) eigenvectors. (auth)

4007 SOME CHAIN YIELDS IN THE ASYMMETRIC FISSION OF ^{232}Th INDUCED BY 3 AND 14.7-MeV NEUTRONS. Lyle, S. J.; Martin, G. R.; Rahman, Md. M. (Univ. of Kent, Canterbury, Eng.). Radiochim. Acta, 9: 90-4(Aug. 1968).

Cumulative chain yields for masses 83, 84, 97, 99, 129, 132, 143, and 145 are reported for fission induced in ^{232}Th by 3-MeV neutrons. Yields for 14.7-MeV neutron-induced fission for the same masses except 132 and 143 but including 131 were also measured. At each initial excitation energy the number of secondary neutrons emitted by several pairs of complementary fragments was calculated; values from 2.3 to 2.4 (at 3 MeV) and 3.6 to 4.0 (at 14 MeV) in good agreement with average published values were obtained. An assessment of the positions of the light and heavy peak maxima suggests that the latter shifts more than the former towards lower masses with increase in initial excitation energy. Implications of this result are discussed. (auth)

4008 THE PROBABILITY OF K-CAPTURE IN THE DECAY OF ^{139}Ce. Adamowicz, B.; Moroz, Z.; Preibisz, Z.; Zglinski, A. (Inst. of Nuclear Research, Swierk, Poland). Acta Phys. Pol., 34: 529-34(1968).

With the application of the coincidence technique, the relative probability of K-capture was determined for the transition from the $^3/_2^+$ ground state of ^{139}Ce to the 166-keV, $^5/_2^+$ level in ^{139}La. This probability is $P_K = 0.75 \pm 0.01$, and the transition energy calculated on the basis of it equals Q = 127 ± 8 keV. The logarithm of the comparative half-life is log ft = 5.7 ± 0.1. (auth)

4009 STUDY OF MUONIC X RAYS FROM SEPARATED ISOTOPES OF EUROPIUM AND FROM LUTETIUM. Suzuki, Marcia Naomi Feinbaum. Pittsburgh, Carnegie-Mellon Univ., 1968. 89p.

Thesis.

The K and L x-rays were observed from muonic atoms of separated isotopes of europium and from lutetium. The study of the two isotopes of europium is of interest because ^{153}Eu is highly deformed, while ^{151}Eu is more nearly spherical; ^{175}Lu is also very deformed. A modified Fermi charge distribution of the form: $\rho(r,\theta) = \rho_0[1 + \exp(r(1 + P_2(\theta)) - c_0A^{\frac{1}{3}})\ 4.4/t]^{-1}$ was used in the analysis of all three nuclei. The ^{153}Eu and ^{175}Lu spectra were analyzed under the assumption of the validity of the rotation model. This model can not be used for ^{151}Eu; and for the analysis of this nucleus, excitation to only the 21.7-keV state was invoked. Values for the charge distribution parameters, c_0 and t, were found for all three nuclei. The intrinsic quadrupole moments, Q_0, for ^{153}Eu and ^{175}Lu were found to be 7.01 ± 0.10 b and 8.02 ± 0.12 b, respectively. For ^{151}Eu, the ratio of the spectroscopic quadrupole moment of the 21.7-keV state to that of the ground state was found to be 1.57 ± 0.24 and the reduced transition probability, B(E2), of the transition to the ground state is $0.054 \pm 0.015\ e^2 10^{-48}\ cm^4$. The magnetic dipole interaction parameter, A_1, for the ground state of ^{151}Eu was also determined. For the muon in the 1s state, $A_1 = 0.80 \pm 0.27$ keV. (Disser. Abstr.)

4010 LIFETIMES OF ^{149}Pm EXCITED STATES. Azimov, K. Sh.; Begzhanov, R. B.; Teshabaev, K. T. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 6, 18-20 (1968). (In Russian).

The existence of the 114-, 189-, 211-, 538-, and -654-keV excited levels of ^{149}Pm were determined by triple coincidence experiments on the decay of ^{149}Nd. (R.V.J.)

4011 QUANTUM CHARACTERISTICS OF ^{99}Tc LEVELS. Azimov, K. Sh.; Begzhanov, R. B.; Gladyshev, D. A.; Sabirov, Kh. S. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 8, 19-21(1968). (In Russian).

In order to determine one-dimensional quantum characteristics of levels and transitions of ^{99}Tc studies were made of γ-γ correlations of (740–180) and (740–140) MeV cascades and the lifetimes of the ^{99}Tc 922- and 180-keV levels. A corrected decay scheme for $^{99}Mo \rightarrow {}^{99}Tc$ is included. (R.V.J.)

4012 EXCITED STATES OF ^{129}I FOLLOWING THE DECAY OF ^{129m}Te. Gonsior, M.; Lizurei, G. I.; Nevodnichanskii, G.; Potempa, A. V. (Inst. of Nuclear Physics, Krakow. Jagellonian Univ., Krakow). Acta Phys. Pol., 34: 511-19(1968). (In Russian).

Beta spectra from the decay of $^{129}Te + {}^{129m}Te$ were measured, together with the associated conversion-electron spectra. Internal conversion coefficients were determined for transitions in ^{129}I. The data obtained were used together with available published data to determine the spins of the 487.4- and 696.9-keV levels of ^{129}I. (R.V.J.)

4013 NEUTRON AND GAMMA RADIATIONS FROM ^{238}Pu. Bubernak, J.; Matlack, G. M.; Metz, C. F. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 457(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4014 RELATIVE ^{238}U FISSION YIELDS BY GAMMA-RAY ANALYSIS. Beller, L. S.; Maddison, D. W. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 607-8 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4015 TRANSMISSION MEASUREMENT OF THE ^{252}Cf FISSION-NEUTRON SPECTRUM. Green, L. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 606-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4016 MONTE CARLO INTERPRETATION OF A ^{238}U SPHERICAL-SHELL TRANSMISSION EXPERIMENT AT 23 keV. Miller, L. B.; Poenitz, W. P. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 606(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4017 MEASUREMENTS OF THE THERMAL-NEUTRON CROSS SECTION OF ^{233}Pa. Connor, J. C. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 605-6(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4018 MEASUREMENTS OF PROMPT AND DELAYED NEUTRONS FROM PHOTOFISSION. Gozani, T.; Bramblett, R.; Kull, L.; Rundquist, D. E. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 659(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4019 SPONTANEOUSLY FISSIONING ISOMERS. Polikanov, S. M. (Joint Institute of Nuclear Studies, Dubna, USSR). Usp. Fiz. Nauk, 94: 43-62(Jan. 1968). (In Russian).

A review is given of the experimental data obtained in the past years on spontaneously fissioning isomers and of the hypotheses proposed on their nature. Eight isotopes, decaying by means of spontaneous fission with abnormally short half-lives, have been synthesized. Four of these isotopes have been identified as isomers of known isotopes. The probability of spontaneous fission of these isomers was increased in comparison with the ground state by 10^{20} times. A series of hypotheses on the possibility of the existence of isomers of different half-lives in the transuranic elements are discussed. The experimental data on the regularity of the formation of spontaneously fissioning isomers of ^{240}Am and ^{242}Am in nuclear reactions yields some conclusions on the properties of the isomeric state. 49 references. (tr-auth)

4020 THE SPECTRUM OF A L AUGER ELECTRONS IN THE DECAY OF ^{175}Hf TO ^{175}Lu. Gizon, J.; Gizon, A.; Valentin, J. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys., A120: 321-8(1968). (In French).

The L-Auger spectrum of ^{175}Lu in the electron-capture decay of ^{175}Hf was studied by means of two iron-free double-focusing 21- and 50-cm radii spectrometers. The energies and relative intensities of 43 lines or groups were measured. The L_3 subshell and mean L-shell fluorescence yields were determined to be ω_{L_3} = 0.19 ± 0.05 and $\bar{\omega}_L$ = 0.29 ± 0.05. (auth)

4021 LIFETIME OF 341-keV LEVEL IN ^{127}Te. Ishii, Kameo; Kageyama, Seizaburo (Tokyo Inst. of Tech.). J. Phys. Soc. Jap., 25: 1186(Oct. 1968).

The lifetime of the 341-keV level in ^{127}Te was measured by the β-γ delayed coincidence technique using an improved time-to-amplitude converter circuit and plastic scintillators. (D.C.W.)

4022 THE ISOMERS ^{101m}Tc, ^{103m}Ru, ^{158m}Tb, AND ^{208m}Bi. Gabsdil, W. (Univ., Heidelberg). Nucl. Phys., A120: 555-60 (1968).

The decay of the isomers in ^{101}Tc, ^{103}Ru, ^{158}Tb and ^{208}Bi produced by 28 MeV bremsstrahlung was re-investigated with a Ge(Li) counter. The previously deduced decay schemes of ^{158}Tb and ^{208}Bi were confirmed. The previously reported isomer in ^{159}Gd was not found by irradiation of a ^{160}Gd sample. It is argued that this isomer is identical with the ^{158}Tb isomer. (auth)

4023 K/L, L_{III}/M_{III}, AND M/(N + O + P) RATIOS IN PURE E2 TRANSITIONS. Nilsson, O.; Thoren, I.; Malmsten, G.; Hogberg, S. (Univ. of Uppsala). Nucl. Phys., A120: 561-8(1968).

Accurate measurements were performed on relative K, L, M and (N + O + P) internal conversion line intensities of some pure E2 transitions in nuclei in the rare-earth region. The results are compared with theoretical values obtained from the calculations by Rose, Sliv and Band, Hager and Seltzer and by Bhalla. Good agreement between experiment and theory is found for the K/L ratios, while the experimentally obtained L_{III}/M_{III} ratios are somewhat lower than predicted by theory. (auth)

4024 DETERMINATION OF RELATIVE INTENSITIES OF M INTERNAL CONVERSION LINES IN PURE E2 TRANSITIONS. Hogberg, S.; Bergmark, J.-E.; Malmsten, G.; Nilsson, O. (Univ. of Uppsala). Nucl. Phys., A120: 569-75(1968).

Accurate measurements were performed on the relative intensities of the M internal conversion lines of three pure E2 transitions in nuclei in the rare-earth region. The results were compared with theoretical values obtained from the calculations by Bhalla and by Hager and Seltzer. Discrepancies of about 6% between experiment and theory are reported for the M_I/M_{II} and M_I/M_{III} ratios of the 80.57 keV transition in ^{166}Er. The M_{II}/M_{III} ratios of the 84.26 keV transition in ^{170}Yb and of the 100.09 keV transition in ^{182}W are significantly lower than predicted by theory. (auth)

4025 ^{203m}Pb DECAY AND M4 TRANSITION PROBABILITIES IN NEUTRON-DEFICIENT LEAD ISOTOPES. Doebler, R. E.; McHarris, Wm. C.; Gruhn, C. R. (Michigan State Univ., East Lansing). Nucl. Phys., A120: 489-92(1968).

The decay of 6.1-sec ^{203m}Pb was examined with a high-resolution Ge(Li) spectrometer, and a 5.1-keV M2 transition was found to compete with the 825.2-keV M4 isomeric transition. The M4 transition probability, thus corrected, is now found to be consistent with those of the other M4 transitions in the lead region. (auth)

4026 NUCLEAR STRUCTURE STUDIES IN THE TELLURIUM ISOTOPES: THE ^{126}Te(d,p)^{127}Te REACTION. Graue, A. (Univ. of Bergen); Hvidsten, E.; Lien, J. R.; Sandvik, G.; Moore, W. H. Contract AT(30-1)2098). Nucl. Phys., A120: 493-512 (1968).

The levels of ^{127}Te were studied with the ^{126}Te(d,p)^{127}Te reaction at 7.5-MeV bombarding energy using the MIT multiple-gap broad-range magnetic spectrograph. A total number of 154 levels were observed below 5.7-MeV excitation energy. The angular distributions of 47 of the emitted proton groups were compared with DWBA stripping calculations to determine the orbital angular momentum of the captured neutrons. Transition strengths $(2J + 1)S_{ln,j}$ were extracted and compared to pairing-theory calculations. The total number of vacancies measured in the $1d_{\frac{3}{2}}$, $3s_{\frac{1}{2}}$, $1h_{\frac{11}{2}}$ and $2d_{\frac{5}{2}}$ states in the target is 6.0, which is considerably lower than the expected value of 7.4 from pairing theory. It is suggested that this discrepancy results mainly from failure of the DWBA theory to predict the correct cross section for the l_n = 5 transition. (auth)

4027 DECAY OF ^{134}Cs. Nagpal, T. S. (Bishop's Univ., Lennoxville, Quebec). Can. J. Phys., 46: 2579-88(Dec. 1, 1968).

The gamma spectrum and the conversion line spectrum of ^{134}Cs were investigated using lithium-drifted detectors. The 563–569 and 796–802 keV doublets were completely resolved for the first time. The energies in keV, relative intensities in percent per disintegration, and dominant multipolarities of the transitions observed are: 475.57(1.6%, E2); 563.06(8.6%, E2); 569.30(13.3%, M1); 604.83 (97.5%, E2); 796.02(87.0%, E2); 801.90(7.9%, E2); 1038.19(1%, M1 + E2); 1168.40(2%, E2); 1365.40(3.5%, E2); and 1580(0.03%, M1 or E2). The present results are consistent with the levels in ^{134}Ba at $0(0^+)$, $605(2^+)$, $1168(2^+)$, $1401(4^+)$, $1580(\leq 2)$, $1643(3^+)$, and 1970 (4^+) keV. There is no evidence for the previously reported levels at 923, 1062, 1374, 1770, and 1854 keV. The intensity of the beta-feeds to the levels at 1970, 1643, 1580, and 1401 keV, respectively, are 24.7%, 1.6%, 0.03%, and 73.7%, as computed from the intensity balance of levels in ^{134}Ba. A modest attempt at comparison between the observed excited levels and theoretical predictions is made. (auth) (CANADA)

4028 DECAY OF 9.2-HR ^{135}Xe. Op de Beeck, Jan P.; Walters, W. B. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-905. J. Inorg. Nucl. Chem., 30: 2881-6 (Nov. 1968). (MIT-905-113).

The decay of 9.2-hr ^{135}Xe was studied using Ge(Li) detectors and coincidence techniques. Sources of ^{135}Xe were prepared by extracting Xe from purified sources of 6.7-hr ^{135}I separated from fission products. Two new γ rays were observed at 158.2 and 407.5 keV, and a new level in ^{135}Cs is proposed at 407.5 keV. Spin assignments are discussed, and the levels of ^{135}Cs are compared with the levels of ^{133}Cs. (auth) (UK)

4029 RECOIL PROPERTIES AND CHARGE DISTRIBUTION IN THE FISSION OF ^{208}Pb BY 450-MeV PROTONS. Panontin, John A.; Porile, Norbert T. (Purdue Univ., Lafayette, Ind.). J. Inorg. Nucl. Chem., 30: 2891-2908(Nov. 1968).

Cross sections and thick target recoil properties were determined for three isobaric nuclides with A = 111 as well as for several other palladium and silver nuclides formed in the fission of ^{208}Pb by 450-MeV protons. The cross sections were used to construct a Gaussian charge distribution. The analysis indicates that the neutron-to-proton ratio of the most probable product, N/Zp, has a value of 1.337 ± 0.008 for A = 103 to 111. The full width at half maximum of the distribution is 1.88 ± 0.04 Z units; the isobaric fission cross section for A = 111 is 6.1 ± 0.4 mb. The recoil data were used to derive, for a given mass chain,

the dependence on atomic number of the average cascade deposition energy, the average total kinetic energy release, and the average separation distance between the primary fragment charge centers. The results are compared with similar data previously obtained for ^{238}U. (auth) (UK)

4030 DECAY OF ^{134}Te. Berg, V.; Fransson, K.; Bemis, C. E. (Research Inst. of Physics, Stockholm). Ark. Fys., 37: 203-12(1968).

An investigation of the decay of ^{134}Te was made using isotope-separated sources. The gamma-ray spectrum was studied with NaI(Tl) and Ge(Li) detectors; and conversion-electron lines were measured in a double-focusing spectrometer. Gamma rays of the following energies in keV (and relative intensities) were assigned to the decay of ^{134}Te: 79.5 (78), 101.4 (1.5), 181.1 (66), 201.5 (31), 210.8 (85), 278.1(75), 434.8 (65), 460.7 (33), 464.4 (16), 565.6 (72), 712.5 (19), 742.0 (53), 766.7 (100). The multipolarity of the 79.5-keV transition was determined to be M1 with a mixing ratio δ^2(E2/M1) < 0.04. The 181.1-, 201.5-, 210.8-, 278.1-keV transitions were found to be M1 or E2 in character. A ^{134}I level scheme is proposed with states at 79.5, 181.1, 210.8, 645.3, 846.6, 923.3, and 1106.1 keV. The half-life of ^{134}Te was measured to be 41.8 ± 0.8 min. Energies and relative intensities for gamma rays arising from the decay of ^{134}I are also reported. (auth) (Sweden)

4031 DECAY PROPERTIES OF THE ^{133}Te ISOMERS. Berg, V.; Fransson, K.; Bemis, C. E. (Research Inst. of Physics, Stockholm). Ark. Fys., 37: 213-19(1968).

Preliminary studies of the decay properties of the isomers of ^{133}Te were made. Transitions in ^{133}I following the decay of the Te parent isotopes were investigated using isotope-separated sources in conjunction with Ge(Li) detectors and a 50-cm double-focusing beta-ray spectrometer. Twenty-eight transitions in the energy range 50 2600 keV were ascribed to the decay of the Te isomers. Transition energies and intensities are reported as well as conversion coefficients for a few of the low-energy transitions. The half-life of the upper isomer was remeasured to be 55.4 ± 0.4 min. (auth) (Sweden)

4032 CORE-EXCITATION MODEL FOR ^{127}I. Castel, B. (Queen's Univ., Kingston, Ont.). Can. J. Phys., 46: 2571-6 (Dec. 1, 1968).

The nuclear properties of low-lying levels of ^{127}I are discussed in terms of a core-excitation model. The core and particle parameters are determined by a simultaneous fitting of the available experimental data into a least-square program. Compared with the predictions of Kisslinger and Sorensen, the calculated results are seen to yield better agreement with the measured E2 transition rates. (auth) Canada)

4033 TOTAL EFFECTIVE NEUTRON CROSS SECTIONS OF O, La, Ce, AND Pr AT 3.2 TO 5.2 MeV. Manero, F. (Junta de Energia Nuclear, Madrid). An. Fis., 64: 63-70(Jan.-Feb. 1968). (In Spanish).

The total neutron cross sections of O, La, Ce, and Pr were measured between neutron energies of 3.2 and 5.2 MeV. The accuracy of the measurements is better than 1.5% for the oxygen, 2.4% for lanthanum and cerium, and 3% for praseodymium. The measurements were taken at intervals of approximately 30 keV in neutron energy and with neutron spreads of ±30 keV. For the measurements of La, Ce, and Pr, the oxides of these elements were used. The corresponding cross section was obtained by substracting the oxygen cross section from the measured oxide cross section. (auth)

4034 THE KLL AUGER SPECTRUM OBSERVED IN THE β DECAY OF ^{233}Pa. Briancon, Chantal (Centre de Spectrometrie Nucleaire, Orsay, France). Compt. Rend., Ser. A and B, 267: 348-50(July 29, 1968). (In French).

The energies and intensities of the different components of the KLL Auger spectrum in the decay ^{233}Pa → ^{233}U were studied. The values were compared with the theory of intermediate coupling between the final lacunas for an atom of high Z. (tr-auth)

4035 YIELDS OF SOME LIGHT-MASS NUCLIDES PRODUCED IN THE PROTON-INDUCED FISSION OF ^{238}U. Khan, A. H.; Saha, G. B.; Yaffe, L. (McGill Univ., Montreal). Can. J. Chem., 46: 3565-72(Nov. 15, 1968).

The formation cross sections of cumulatively formed ^{66}Ni, ^{67}Cu, ^{72}Zn, and ^{73}Ga, and of independently formed ^{68}Ga, ^{70}Ga, and ^{72}Ga produced in fission of ^{238}U, induced by protons of energy 20 to 85 MeV, were determined. The measured yields correlate well with the data obtained by others at higher energies. From the ratios of the independent and cumulative formation cross sections of ^{72}Ga and ^{72}Zn, respectively, a value of Z_p, the most probable nuclear charge, for A = 72 was determined for different widths of the charge dispersion curves. (auth) (Canada)

4036 $\beta-\gamma$ ANGULAR CORRELATIONS IN DECAY OF ^{94}Nb. Hoquenhem, J. C.; Berthier, J. Ark. Fys., 37: 261-6(1968). (In French).

The directional angular correlation between the 470-keV beta of ^{94}Nb and ^{94}Mo 703- and 871-keV gamma's were measured. The values of $A_2(E)/A_0(E)$ were extracted from the experimental results. Comparison with the same quantities calculated theoretically with the assumption of a spin 7^+ for the fundamental level of ^{94}Nb allows us to reject this hypothesis and so to confirm the 6^+ spin value for this level. (auth) (Sweden)

4037 STUDY OF THE ALPHA SPECTRA OF ^{233}U. Gaeta, Rafael; Butragueno, J. Luis; Monleon, J. L. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 165-9(May-June 1967). (In Spanish).

The spectrum of the alpha particles emitted by ^{233}U was studied using a semiconductor counter spectrometer. 11 previously unreported lines were identified. (auth)

4038 ON THE DECAY OF ^{136}I. Lundan, A.; Siivola, A. (Technical Univ. of Helsinki, Otaniemi, Finland). Ann. Acad. Sci. Fenn., Ser. A VI, No. 288, 1-15(1968).

Gamma rays following the beta decay of the 83 s ^{136}I were investigated using Ge(Li) and NaI(Tl) detectors and a 4096-channel two-parameter spectrometer. Iodine was chemically separated from other thermal neutron fission products of natural uranium. A total of 21 gamma rays were assigned to the decay of ^{136}I. According to the proposed level scheme these depopulate 14 levels in ^{136}Xe at 1313, 2582, 2633, 2867, 3015, 3213, 3238, 3584, 3601, 3609, 3727, 4290, 4349, and 4467 keV. The gamma rays descending from the 3609-, 3238-, and 3213-keV levels also have a shorter-lived component with a half-life of 40 ± 5 s. This is thought to be due to an isomeric state in ^{136}I that decays by beta emission to the energy levels of ^{136}Xe. Two transitions with energies 272.4 ± 0.2 keV and 435.1 ± 1.5 keV and half-lives 3.5 ± 0.2 min and 5.5 ± 0.6 min, respectively, were also found. They seem to belong to other short-lived fission-product iodine isotopes. A 1216.7-keV gamma ray, whose half-life was measured as 23 ± 4 s, was also seen, and is tentatively assigned to the decay of the 23 s ^{136}I. (auth)

4039 THE ISOTOPE SHIFT IN ^{206}Bi. Magnante, Peter Carmine. New York, New York Univ., 1968. 167p.

Thesis.

The optical spectra of ^{209}Bi (10^{18}y) and ^{206}Bi (6.3d) were measured using a high-resolution Czerny-Turner spectrograph having a 30-foot focal length. The ^{206}Bi was obtained at the Harvard cyclotron by a ^{208}Pb (p,3n) reaction. A radiochemical procedure was developed for separating the radioactive bismuth from the lead target and transferring it into an electrodeless lamp. From an analysis of the hyperfine structure patterns, a value of 123 ± 13 mK was obtained for the isotope shift of the 3067Å resonance line for the ^{209}Bi – ^{206}Bi pair. Measurements in the 4722Å line also were obtained but were considered unreliable because of the dense background spectrum. An interpretation of the measured isotope shift is given, and the importance of the odd proton in bismuth is discussed. In particular, the effect of the angularity asymmetric distribution of the bismuth odd $h_{\frac{9}{2}}$ proton on the isotope shift may be greater than the effect of the thallium symmetric odd $s_{\frac{1}{2}}$ proton which is known to be small. (Disser. Abstr.)

Nuclear Theory

Refer also to abstracts 3669, 3891, 3927, 3930, 3938, 3939, 3941, 3943, 3953, 3954, 3962, 3972, 3997, 4002, 4006, 4019, 4032, and 4447.

4040 (BMwF-FBK-68-30) APPLICATIONS OF GROUP THEORY IN THE NUCLEAR SHELL AND CLUSTER MODEL. Kramer, P. (Tuebingen Univ. (West Germany). Institut fuer Theoretische Physik). July 1968. 112p. (In German). Dep.

For the calculation of properties of light nuclei, methods of group theory are applied to the states of the harmonic oscillator shell model and of the cluster model. Fractional parentage coefficients are used to express the matrix elements of arbitrary interactions in terms of a small number of two-particle matrix elements. The methods are applied to the states of four nucleons. (auth)

4041 (EUR-3908) SIMPLIFIED METHOD FOR KINEMATIC CALCULATIONS OF NUCLEAR REACTIONS. Winter, J.; Schmid, H. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 1968. 12p. Dep.

A simplified method of presentation of kinematic relations in nuclear reactions is given. It allows obtaining in a convenient way the energy of the reaction products as a function of the angle of

emission in the laboratory frame for non-relativistic reactions. It has been shown that after the introduction of normalized quantities the kinematics of all nonrelativistic reactions may be calculated by means of only one equation. To facilitate handling, this equation has been tabulated. In the single-valued region ($0 \leq \eta \leq 1$), the incremental step of the parameter η is 0.01; and the angle θ increases in steps of 5° from 0 to 180°. In the double-valued region ($\eta > 1$), tabulation of η is given only up to $\eta = 2$, the incremental steps being 0.02 and 5°. (auth)

4042 (IAE–1465) PHASE TRANSITION IN HEAVY NUCLEI. Nosov, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1967. 24p. (In Russian). Dep.

Toward the end of the periodic table, the equilibrium surface of the nuclei becomes gradually less and less spherical. Rotational bands based on the ground state appear in the case of the ^{150}Sm to ^{152}Sm transition; a sudden increase of the moment of inertia appears also in the case of ^{152}Gd to ^{154}Gd. Between ^{190}Os and ^{192}Os the nucleus becomes less spherical; a similar behavior reappears between Rn and Ra. A theory was developed to explain the phenomena observed in the neighborhood of the phase transformation curve on the N – Z plane, correlating energies and N and Z values. The problem is illustrated by a specific example: the 2^+ level characterizing even-even nuclei has not yet been observed in the case of the doubly magic ^{208}Pb; but its neighbors, such as the $^{200,210-214}$Pb isotopes, do possess 2^+ levels. No final solution of the problem is as yet available. (TTT)

4043 (IS-T–269) DEFORMED POTENTIAL MANY-PARTICLE THEORY. Draeyer, Jerry Paul (Ames Lab., Iowa). Aug. 1968. Contract W-7405-eng-82. 157p. Dep. CFSTI. Thesis.

The relation between the U(3) ⊃ R(3) state labeling scheme introduced by Elliott for a description of many particles moving in an isotropic harmonic oscillator potential and the Gel'fand U(3) ⊃ U(2) × U(1) state labeling scheme introduced by Nagel and Moshinsky is established. A rule complementary to the one given by Elliott for the quantum number K required in the U(3) ⊃ R(3) reduction is given and the use of K in state labeling is clarified. An explicit expression for the transformation brackets between the two state labeling schemes is obtained and the results used to derive an explicit expression for both the U(3) ⊃ R(3) coupling coefficients and projected tensor matrix elements. Application of the invariance of the commutators of the infinitesimal generators of U(3) to a canonical transformation is used to generalize these results to a deformed potential many-particle theory. An expansion of the deformed potential many-particle states in terms of the nondeformed potential many-particle states is made. A phenomenological description of the motion of nucleons in a deformed potential created by a deformed core which itself is allowed to rotate adiabatically is presented. An application to the A = 18 system is made, treating ^{18}O as having two particles moving in a deformed potential created by the ^{16}O core. (auth)

4044 (ITEF–591) IDENTIFICATION OF THE MECHANISM OF STRAIGHT PROCESSES WITH THE FORMATION OF THREE PARTICLES. Shapiro, I. S.; Kolybasov, V. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 26p. (In Russian). Dep.

The identification of reaction mechanisms is discussed. Both the types of experiments and the methods of data analysis that are required to determine reaction mechanisms are considered. It is pointed out that even for such thoroughly studied reactions as the (p,2p) reaction, insufficient information has been obtained to permit determination of the mechanism. The necessity of measuring all independent variables under conditions that permit comparison with theory is emphasized. (D.C.W.)

4045 (ITEF–605) POLARIZATION EFFECTS IN DIRECT NUCLEAR REACTIONS WITH THE FORMATION OF THREE PARTICLES. Kolybasov, V. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 24p. (In Russian). Dep.

Polarization phenomena are considered for the case in which the amplitude is dominated by pole graph. The polarization and the alignment of the residual nucleus, and the asymmetry in reactions on polarized targets, are expressed in terms of the polarization of the particles involved in the virtual two-body reaction. The results can be used for identification of the reaction mechanism and for determination of the residual nucleus spin. (auth)

4046 (JINR–E3-4062) MAGNETIC MOMENT MEASUREMENTS FOR SHORT-LIVED NUCLEAR STATES. Khrynkevich, A. Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 35p. Dep.

A general review of methods used for measuring magnetic moments of short-lived nuclear states is given. Principles, possibilities, and limitations of methods based on the Moessbauer effect and on the angular correlation of nuclear radiations are presented in more detail; and some recent methodical refinements are described. (auth)

4047 (JINR–E4-4015) MULTI-STEP STRIPPING ON DEFORMED NUCLEI. Luk'yanov, V. K.; Petkov, I. Zh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 9p. Dep.

The expression for the stripping cross section on deformed nuclei was analyzed. Using the diffraction approximation, the multi-step character of the (d,p) stripping reaction is revealed. As an example, the reaction ^{24}Mg(d,p)^{25}Mg with transition to the levels $5/2^+$(g.s.) and $7/2^+$ (1.61 MeV) is considered. (auth)

4048 (JINR–E4-4043) COORDINATES AND OBSERVABLES IN THE NUCLEAR THREE-BODY PROBLEM. Niri, Yu.; Smorodinskii, Ya. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 32p. Dep.

For a system of three particles, coordinates and operators of SU(3) representations on the six-dimensional sphere are constructed. A method for calculating harmonic functions is given. Two types of harmonic functions (K and B polynomials) are considered. (auth)

4049 (JINR–E4-4075) QUADRUPOLE ONE-PHONON STATES OF EVEN-EVEN NUCLEI IN THE REGION $150 \leq A \leq 174$. Korneichuk, A. A.; Malov, L. A.; Solov'ev, V. G.; Fedotov, S. I.; Schul'ts, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 21p. Dep.

The energies and the wave functions of the two first one-phonon states of the quadrupole type in even-even deformed nuclei are calculated on the basis of the superfluid nuclear model, in the framework of the approximate second quantization method. The one-particle energies and the wave functions of the Woods-Saxon and Nilsson potentials for deformed nuclei are used in the calculations. Some advantages of the calculations based on the Woods-Saxon potential as compared to those based on the Nilsson potential are indicated. It is shown that for the overwhelming majority of nuclei the experimental energies of the first $K^\pi = 2^+$ states and the corresponding values with the same constant $\kappa^{(2)}A^{1/3} = 2.5$ MeV/cm^2 and the effective charge $e^2_{eff} = 0.2$ are well described. The characteristics of the one-phonon states serve as a basis for further study of the deformed nucleus structure. (auth)

4050 (JINR-P4-4054) EQUILIBRIUM DEFORMATIONS OF THE GROUND AND EXCITED STATES OF THE NUCLEI IN THE RANGE $50 < Z, N < 82$. Arsen'ev, D. A.; Sobichevski, A.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 46p. (In Russian). Dep.

The dependence of the energy of the ground states of the even, odd, and odd-odd nuclei on β and γ deformations was calculated for $0 \leq \beta \leq 0.5$ and $0 \leq \gamma \leq 60°$. The energy, considered as a function of these parameters, has two minima. In the region of ^{126}Ba deeper minima of some nuclei lie at $\gamma = 60°$. When passing from one minimum to another, no essential energy barrier was observed. Therefore these nuclei will be "soft" with respect to the γ deformations. Investigation of the behavior of the excited states in these nuclei leads to a conclusion about the presence of the states which are shape isomers. (auth)

4051 (JINR-P4-4073) QUADRUPOLE AND OCTUPOLE ONE-PHONON STATES IN THE REGION $174 \leq A \leq 188$. Malov, L. A.; Solov'ev, V. G.; Fainer, U. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 10p. (In Russian). Dep.

On the basis of the superfluid nuclear model, the energies of the $K^\pi = 0^+$, 2^+ quadrupole and $K^\pi = 0^-$, 1^-, and 2^- octupole states were calculated as well as the reduced probabilities B(E2) and B(E3). The calculations were performed for the schemes of the one-particle levels and the wave functions of the Nilsson potential with the term $\langle l^2 \rangle$ with the deformation $\beta = 0.21$ and of the Woods-Saxon potential with the deformation $\beta = 0.23$. Good agreement with experiment was obtained. In calculations based on the Woods-Saxon potential, $\kappa^{(2)} = 184\ A^{-5/3}$ MeV/cm^4 and $\kappa^{(3)} = 0.04\ A^{-5/3}$ MeV/cm^6 were chosen for the quadrupole and octupole interactions, respectively. B(E2) and B(E3) were calculated for $e_{eff} = 0.2$. The obtained characteristics of the one-phonon states serve as a basis for further study of the deformed nucleus structure. (auth)

4052 (KFK-767) ESTIMATION OF UNKNOWN EXCITATION FUNCTIONS FOR (α,xn), (α,pxn), (d,xn), (d,pxn), and (p,xn) REACTIONS. Lange, Juergen; Muenzel, Helmut (Kernfo-

rschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). May 1968. (In German). 36p. Dep.

A procedure for constructing unknown excitation functions is outlined. A compilation of experimental data is presented; and constructed and experimental excitation functions for several mass regions are compared. 78 references. (D.C.W.)

4053 (NP-17506) PHENOMENOLOGICAL AND MICROSCOPIC ANALYSIS OF PROPERTIES OF EVEN-EVEN NUCLEI. Heras, C. A. (La Plata Universidad Nacional (Argentina)); Abecasis, S. M.; Bosch, H. E. (Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina)). May 1968. 439p. Dep. CFSTI.

A survey is given of microscopic and phenomenological models for even-even nuclei. Attempts to derive collective behavior from particle dynamics are also covered. Extensive lists of references are included. (D.C.W.)

4054 (NP-17611) AUTOMATION OF A NUCLEAR EXPERIMENT ON THE 4-MeV ELECTROSTATIC ACCELERATOR OF THE FTI OF THE ACADEMY OF SCIENCES, USSR. PART I. Yamnitskii, V. A.; Makarov, A. F.; Kopanets, E. G.; Korda, Yu. S.; Tsytko, S. P.; Zeidlits, P. M. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1967. 97p. (In Russian). Dep.

An automated data acquisition and analysis system for experiments on (p,γ) and $(p,p'\gamma)$ reactions is described. (D.C.W.)

4055 (NRL-6783) EMPIRICAL APPROACH TO THERMAL NEUTRON ABSORPTION CROSS SECTIONS. Podgor, S. (Naval Research Lab., Washington, D. C.). Sept. 26, 1968. 9p. CFSTI.

A simple procedure is proposed to simulate the cyclic variation of the thermal neutron absorption cross sections of the odd-Z, even-N nuclei. The assumption is made that the cross sections vary with the number of protons in the last open proton shell, and the number of neutron holes in the last open neutron shell. With the major nuclear shells as a basis and with variations as to which subshells are included, empirical results are obtained and are compared with the experimental cross-section curve. Preliminary indications are that the proposed method gives results that follow the trend of the experimental data. (auth)

4056 ASYMPTOTIC BEHAVIOR OF THE COULOMB-NUCLEAR S-MATRIX ALONG THE IMAGINARY λ-AXIS. Shastry, C. S. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., B7: 355-8(1968).

The asymptotic behavior of the "nuclear" S-matrix of the Coulomb-nuclear problem is established along the imaginary axis in the complex angular momentum plane for the case of a Yukawa-type "nuclear" potential and it is found to be the same as for the pure Yukawa case. (auth)

4057 A FINITE-RANGE, TWO-MODE, GENERALIZED DISTORTED-WAVE BORN-APPROXIMATION ANALYSIS OF DIRECT NUCLEAR REACTIONS. Talley, Thurman Lamar. Tallahassee, Florida State Univ., 1968. 213p.

Thesis.

The theory of direct nuclear reactions was used to develop a procedure for a finite-range DWBA calculation using both direct and exchange modes. This procedure was designed to allow great flexibility of use including the ability to perform detailed interaction investigations. An example of the improved computational ability is the two-mode, finite-range calculation of the reaction $^{9}Be(p,\alpha)$. It is shown that neither the direct nor the exchange mode can reproduce the experimental data separately; but rather, both modes are necessary to obtain successful fits. An estimate of the cluster model reduced widths was made from the parameters which give the best agreement with the data. (Disser. Abstr.)

4058 PARTICLE-HOLE EXCITATIONS WITH A SUM OF SEPARABLE INTERACTIONS. Blomqvist, J. (Research Inst. for Physics, Stockholm. Royal Inst. of Tech., Stockholm). Phys. Lett., 28B: 22-5(Oct. 28, 1968).

The surface delta interaction is generalized to a sum of interactions on spherical shells with different radii. The interaction is used in an RPA calculation of the collective 3^- state in ^{208}Pb. The $3\hbar\omega$ excitations are found to be important for the transition strength. (auth)

4059 WHAT CONFIGURATION MIXING CAN BE CONCEALED IN NUCLEAR SHELL MODEL CALCULATIONS? Engel, M. Y.; Unna, I. (Hebrew Univ., Jerusalem). Phys. Lett., 28B: 12-14 (Oct. 28, 1968).

A modification of the pseudonium nuclei model shows that most types of configurations mixing can not be concealed in shell model calculations. It is still possible to conceal configurations mixing in the ground states. This provides a clear indication as to the limited types of configurations mixing which can be concealed in shell model calculations. (auth)

4060 DETERMINATION OF SPINS OF RESONANCE STATES. Goldfarb, L. J. B.; Seyler, R. G. (Ohio State Univ., Columbus). Phys. Lett., 28B: 15-17(Oct. 28, 1968).

A procedure is proposed for determining spins of isolated nuclear resonances by coincidence measurements of the reaction product and de-excitation γ rays. The measurements exploit only the azimuthal dependence of the γ-ray distribution function. (auth)

4061 n-p SURFACE DELTA INTERACTION AND COUPLED BCS EQUATIONS IN SPHERICAL OFF-MASS NUCLEI. Reya, E. (Univ., Vienna); Baier, H. Nuovo Cim., 58B: 384-7(Nov. 11, 1968).

It is shown that a simple residual interaction between identical as well as nonidentical nucleons can explain the pairing properties of nuclear spectra in the regions $40 \leq Z \leq 49$, $53 \leq N \leq 70$ and $51 \leq Z \leq 59$, $64 \leq N \leq 82$. A surface delta interaction simulates the force between the nucleons. By applying Bogoliubov's compensation principle to protons and neutrons separately, the coupled system of n-p pairing equations is derived; and numerical solutions are obtained. (D.C.W.)

4062 SYSTEMATIC BEHAVIOR OF THE COLLECTIVE PARAMETERS CORRESPONDING TO SOME EVEN NUCLEI. de Aisenberg, E. Y.; Suarez, J. F. (Comision Nacional de Energia Atomica, Buenos Aires). Nuovo Cim., 58B: 347-51 (Nov. 11, 1968).

A model by which the low-energy positive-parity states of some even nuclei can be explained as stationary states of collective motion in terms of three parameters is considered. The systematic behavior of the parameters of the model is examined in detail. (D.C.W.)

4063 PATHOLOGICAL SEPARABLE POTENTIALS. Law, J. (McMaster Univ., Hamilton, Ont.). Nuovo Cim., 58B: 258-68(Nov. 11, 1968).

Using positive-model phase shifts which differed in the high-energy region, the corresponding unique separable potentials were derived. The potentials were then compared by performing a simple nuclear-matter binding-energy calculation. It was found that in some cases, the larger positive phase shift can give a smaller binding in nuclear matter in contradiction to what one would expect from physical arguments. (auth)

4064 FOUR-BODY INTERACTION IN NUCLEAR SHELL-MODEL CALCULATIONS. Boffi, S.; Miglietta, F. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Nuovo Cim., 58B: 313-22(Nov. 11, 1968).

A four-body potential is used in shell-model calculations as an alternative possibility of describing cluster structures in nuclei. Volume- and surface-contact interactions are considered as simple examples. Application to ^{20}Ne shows good agreement in predicting the energy spectrum in the case of surface interaction, but fails in evaluating B(E2) transitions, especially at high excitations, where two-body forces (here neglected) surely predominate. (auth)

4065 HIGH-ENERGY K-CONVERSION COEFFICIENTS. Carroll, C. O. (Nuclear Chicago Corp., Des Plaines, Ill.); O'Connell, R. F. Phys. Lett., 28A: 105-6(Nov. 4, 1968).

High-energy K-conversion coefficients are calculated using relativistic Hartree-Fock-Slater wave functions. It is shown that above about 1.5 MeV there is serious disagreement between the theoretical and recent experimental results. (auth)

4066 BINDING ENERGY CALCULATIONS FOR FINITE NUCLEI WITH TENSOR FORCES. Stack, S. J. (Oxford Univ.). Nucl. Phys., A120: 241-53(1968).

The method of Nickel, Tomusiak, and Peierls for computing nuclear binding energies is extended to deal with tensor forces. A second-order calculation is carried out for ^{16}O using the Hamada-Johnston potential. It is found that the method is not useful when the simple harmonic oscillator potential is used as the shell model potential of the unperturbed Hamiltonian. It is suggested that the convergence of the perturbation series can be improved if the single-particle potential is modified so as to be approximately self-consistent. (auth)

4067 CALCULATION OF THE SECOND-ORDER GOLDSTONE DIAGRAM IN NUCLEAR MATTER. Davies, K. T. R. (Oak Ridge National Lab., Tenn.); Baranger, M. Nucl. Phys., A120: 254-72(1968).

A comparison is made of various methods used to calculate the second-order energy in nuclear matter. A general expression is

derived for integrands depending only on k^2, k'^2 and $k \cdot k'$, where k and k′ are relative momenta. It applies to any potential, local or nonlocal, which can be expanded in partial waves of the relative motion, and this allows the exchange term to be combined with the direct term. Because of the short range of the nuclear force, only a few terms in the partial wave expansion are necessary. The number of integrations that need to be performed numerically for each new potential is reduced to two. Special formulas are presented for central, tensor, spin-orbit, and velocity-dependent forces. (auth)

4068 SPECTROSCOPY OF MIXED-PARITY CONFIGURATIONS (PSEUDO-NUCLEI). Gupta, Raj K.; Trainor, L. E. H. (Univ. of Toronto). Nucl. Phys., A120: 273-84(1968).

A pseudo-nuclear model of mixed-parity configurations $1p_{\frac{1}{2}}$ and $1d_{\frac{5}{2}}$ was analyzed for both degenerate and non-degenerate cases. It is found that concealed configuration mixing can occur provided non-degeneracy is allowed in the model. A comparison with earlier pseudo-nuclear models suggests that the contribution of core excitation to low-lying energy levels is more pronounced when only two-particle, two-hole excitations occur than when one-particle, one-hole excitations also make significant contributions. In principle, a systematic study of inelastic electron scattering is shown to be a sensitive method for detecting the configuration interactions in both even- and odd-parity configurations. (auth)

4069 THE BINDING ENERGY OF A Λ PARTICLE IN NUCLEAR MATTER: A GREEN FUNCTION FORMULATION. Burkhardt, Theodore W. (Max-Planck-Institut fuer Physik and Astrophysik, Munich). Nucl. Phys., A120: 434-40(1968).

Formulas relating the binding energy of a Λ particle in nuclear matter to single-particle Green functions of the Λ particle are derived and discussed. (auth)

4070 THREE-POINT-CHARGE MODEL FOR TERNARY FISSION. Katase, Akira (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap., 25: 933-45(Oct. 1968).

Trajectories of three point charges are computed two-dimensionally to analyze the experimental data of ternary fission. In the case of a fission accompanied by a long-range alpha particle (LRA fission), the final value of emission angle of the alpha particle is found to depend mainly on the values of the fragment mass ratio and the ratio x, where $x = D_a$ (distance between emission point and light fragment)/D_f (distance of two fragments at scission). The distributions of E_a, D_f, and the initial total kinetic energy of two fission fragments are obtained for LRA fission of ^{252}Cf. Most of fragments are shown to have already about one-third of the final kinetic energy at scission. (auth)

4071 MUON CAPTURE RATES USING SHELL MODEL AND NILSSON'S MODEL: GENERAL THEORY. Galindo, A. (Univ., Madrid); Pascaual, P. An. Fis., 64: 215-25(July-Aug. 1968).

A general theory for the capture rate and asymmetry parameter of the recoil nucleus in the radiative capture of polarized muons in both hyperfine states was recently formulated (Nucl. Phys., B4: 295(1968)) without relativistic corrections. A specialization of the theory to the case in which the initial and final nuclei can be described either with the shell model with configuration mixing or with Nilsson's model is outlined. (D.C.W.)

4072 RELATION BETWEEN THE TIME-DEPENDENT HARTREE–FOCK METHOD AND BOSON EXPANSION METHODS IN A TWO-LEVEL MODEL. Johnson, R. E. (McMaster Univ., Hamilton, Ont.); Klein, Abraham; Dreisler, R. M. Ann. Phys. (N. Y.), 49: 496-512(Oct. 1, 1968).

This paper continues the study of the two-level model utilized in the preceeding paper. First the boson expansion method is reformulated from a viewpoint which emphasizes its relation to the phenomenological description of vibrations. In this version a general method for reaching the limit of large particle numbers is described and carried out, resulting in a complete theory for finding the asymptotic form (semiclassical limit) of any collective parameter. An exact formulation of the theory in terms of single-particle coefficients of fractional parentage is then described. The semiclassical limit of this theory is recognized as a version of a generalized self-consistent cranking model or time-dependent Hartree–Fock theory. The two semiclassical limits are shown to be identical. The equivalence of time-dependent Hartree–Fock theory to the asymptotic form of more complete theories of collective motion is argued to be general. (auth)

4073 STUDY OF BOSON EXPANSION METHODS IN AN EXACTLY SOLUBLE TWO-LEVEL SHELL MODEL. Pang, S. C.; Klein, Abraham; Dreizler, R. M. (Univ. of Pennsylvania, Philadelphia). Ann. Phys. (N. Y.), 49: 477-95(Oct. 1, 1968).

A two-level numerically soluble shell model previously utilized by Lipkin, Meshkov, and Glick to investigate the accuracy of the random phase and related approximations is applied to the study of boson expansion methods for the description of a vibrational spectrum. Since the model is expressed completely in terms of quasi-spin operators, the required correspondence to boson operators is given by well-known results from the theory of ferromagnetism. The expansions required are also obtained independently by the methods current in nuclear physics. The spectra computed from several harmonic and anharmonic oscillator approximations to the exact Hamiltonian are compared with the results of an exact diagonalization, and possible analogies with the case of vibrational nuclei are drawn. (auth)

4074 PARTICLE–HOLE EXCITATIONS WITH A COMPLETE SINGLE-PARTICLE BASIS. II. SCATTERING AMPLITUDES AND RESONANCES. Agodi, A.; Catara, F.; Di Toro, M. (Univ., Catania, Italy). Ann. Phys. (N. Y.), 49: 445-76(Oct. 1, 1968).

An analysis is reported of the continuous spectrum of the particle-hole Hamiltonian whose point spectrum was investigated in a previous paper. The scattering amplitudes were calculated in the space of all particle–hole states constructed upon the ^{16}O shell-model ground state, in the 1^-, 2^-, and 3^- channels with T = 1, corresponding to elastic and inelastic scattering of neutrons on ^{15}N, up to 10-MeV incident energy. The opening of the inelastic channels is properly taken into account. A complete nonredundant basis of p–h states was used such that the Hartree–Fock scattering is a sort of "orthogonality scattering." It turns out that this orthogonality scattering appears as a reasonable approximation to the "optical model" scattering as determined with "ad hoc" choice of a single-particle potential. The resonances were directly determined from the spectral function of the total Hamiltonian by studying the behavior of its resolvent, reduced in the subspace of the TD states, at energy values above the continuum threshold E_c, i.e., with a method strictly analogous to that employed to get the point spectrum below E_c. It is shown that to describe the structure of the nuclear system at a single resonance a single TD state is insufficient and one needs not only (as obvious) the scattering states but also the other (and possibly all) TD states. (auth)

4075 FORM FACTOR CALCULATIONS IN DIRECT REACTIONS. Hutton, J. L. (Univ. of Liverpool). Nucl. Phys., A120: 657-77(1968).

Exact methods of calculating the form factors for pick-up reactions when the target nucleus consists of two particles outside a closed shell are discussed. The form factors given by various prescriptions including the conventional separation energy prescription are compared for the reaction $^{58}Ni(p,d)^{57}Ni$. It is shown that the conventional treatment of the form factors leads to errors in both the angular distributions and spectroscopic factors from DWBA analysis. Also a more exact treatment of the form factor contributes to a partial explanation of the observed j-dependence of the forward peak of some angular distributions. (auth)

4076 THE SELF-CONSISTENT STRUCTURE OF LIGHT NUCLEI. II. Irvine, J. M. (Cornell Univ., Ithaca, N. Y.). Nucl. Phys., A120: 576-92(1968).

Using methods developed in an earlier work, the ground state structures of a number of light nuclei $A \leq 40$ are studied. All calculations are based on the Reid soft-core potential from which a local density-dependent nuclear-matter approximation to the Brueckner-Bethe-Goldstone reaction matrix has been calculated by Siemens. The Kuo and Brown approximation to the effective interaction is found not to produce sufficient saturation. Both the exact and an effective charge approximation effect of the static Coulomb interaction are studied. Binding energies which are in agreement with the experimental results are obtained (except for the very light nucleus ^4He); however, the density distributions are considerably more compact than those currently predicted by electron scattering experiments unless the density dependence of the reaction matrix is included self-consistently. (auth)

4077 A CALCULATION OF SOME PARAMETERS IN MIGDAL'S THEORY OF NUCLEI. Baeckman, S.-O. (NORDITA, Copenhagen). Nucl. Phys., A120: 593-621(1968).

Some of the parameters in Migdal's theory of nuclei were calculated. Landau's phenomenological approach was used to obtain the quasi-particle interaction. The energy was calculated by Brueckner's theory. Effective interactions were used which in infinite nuclear matter give the same potential energies in ($^1S_0$ + $^1D_2$) and ($^3S_1$ + $^3D_1$) states as the Hamada-Johnston potential. Other contributions to the binding energy were neglected. The nuclear compressibility K was calculated both from the energy-versus-density curve and from the calculated parameters of Migdal's theory. The results were not in conflict with each other. The values of K obtained were 100 to 150 MeV, which agrees reason-

ably well with other calculations in infinite nuclear matter, but they are only about ½ of the values used by Migdal and collaborators. We obtained 0.7 for the effective mass and 22 to 25 MeV for the symmetry energy. The latter result agrees reasonably well with empirical values. An attempt to use the Green function approach in the calculations of the parameters was not successful because of poor convergence, if any. (auth)

4078 CENTRAL AND TENSOR FORCE MATRIX ELEMENTS FOR ARBITRARY AVERAGE AND TWO-BODY POTENTIALS. Shah, Jyoti (Univ., Frankfurt am Main). Nucl. Phys., A120: 530-4(1968).

A general method is described for computing central as well as tensor force matrix elements for shell-model states. The method consists of expanding the two-body potential into free multipole fields. The advantages of the method are that arbitrary forms of the average and two-body potential can be chosen; even in the case of a finite-range force, double integrals are eliminated, and the radial integrals are independent of the shape and parameters of the two-body force; and the central and the tensor forces are treated on the same footing. FORTRAN codes employing this method are available for the computation of the two-body force matrix elements for an arbitrary nucleus. (auth)

4079 A SIMPLE EXTENSION OF THE BCS METHOD FOR WEAKLY DEFORMED NUCLEI. Hendekovic, J. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys., A120: (1968).

The BCS gap equation is extended to the case of weakly deformed nuclei in such a way that a spheroidal deformation can be expressed in the spherical base by means of the non-spherical distribution of occupation probabilities. The extension is made so that the consistency condition is satisfied, i.e., a density of particles follows a deformation of the average field. Any two-body residual interaction can be used so that the possibility of a simple description of weakly deformed nuclei is offered without restriction to the pairing plus quadrupole force. The problem of including a resistance of the core to deformations is discussed and a numerical illustration of the method presented is given. (auth)

4080 ION-ION POTENTIALS AND THE COMPRESSIBILITY OF NUCLEAR MATTER. Scheid, Werner; Ligensa, Rainer; Greiner, Walter (Univ. of Virginia, Charlottesville. Univ., Frankfurt am Main). Phys. Rev. Lett., 21: 1479-82(Nov. 18, 1968).

With a schematic model for the nuclear matter, a unified treatment is given of the real and imaginary parts of the elastic $^{16}O-^{16}O$ scattering potential. The model connects the parameters of the potential with the density and binding properties of the $^{16}O-^{16}O$ system and reproduces the structure of the excitation function quite well. It is shown that the nuclear compressibility can be obtained from the scattering data, and in the case of the ^{32}S compound system there results an effective compressibility (finite quenching of the nuclei) of about 200 MeV. (auth)

4081 CONTRIBUTION TO THE THEORY OF NUCLEAR REACTIONS WITH ALLOWANCE FOR THE RADIATIVE CHANNELS. Kolomiets, V. M.; Tsekhmistrenko, Yu. V. Ukr. Fiz. Zh., 13: 1415-23(Sept. 1968). (In Russian).

A theory of nuclear reactions caused by slow neutrons such as (n,n), (n,γ), and (n,n'γ) is formulated. When finding the T-matrix, the method of Rodberg and Macdonald is used. The resonant part of the total amplitude is expressed through intermediate states which are determined by some model Hamiltonian. It is shown that independently of choice of the model Hamiltonian, the resonant part of the amplitude has the Breit-Wigner form. In a particular case, the well-known mechanism (2p1h) of "doorway states" can be obtained. (auth)

4082 THE TALMI TRANSFORMATION FOR DIFFERENT PARTICLES: A COMPLETE CONSTRUCTION AND NEW RESULTS. Gal, A. (Massachusetts Inst. of Tech., Cambridge, Mass.). Contract AT(30-1)2098. Ann. Phys. (N. Y.), 49: 341-56(Oct. 1, 1968).

The transformation from single-particle coordinates to relative and center-of-mass coordinates for two particles moving in a common harmonic-oscillator potential well is generalized to include the case of different single-particle frequencies. The physical implications, particularly for hypernuclear structure calculations, are pointed out. Explicit expressions for the transformation matrix are obtained which show the group-theoretical structure of the transformation. A generalization to n-dimensional harmonic-oscillators is straightforward. As a by-product the Clebsch-Gordan series for a direct product of two symmetric SU(n) irreducible representations is derived. (auth)

4083 ADLER-WEISBERGER SUM RULE AND THE GOLDBERGER-TREIMAN RELATION FOR NUCLEI. Seki, R. (Univ. of Denver. Univ. of Georgia, Athens). Phys. Rev. Lett., 21: 1494-6(Nov. 18, 1968).

Including nuclear disintegration due to the pion absorption and the effect of the nuclear excited states, the nuclear Adler-Weisberger sum rule is shown to be valid satisfying the Goldberger-Treiman relation. (auth)

4084 INTERNAL CONVERSION TABLES. PART II. DIRECTIONAL AND POLARIZATION PARTICLE PARAMETERS FOR Z = 30 TO Z = 103. Hager, R. S.; Seltzer, E. C. (California Inst. of Tech., Pasadena). Nucl. Data, Sect. A, 4: 397-641(Oct. 1968).

Values of particle parameters used for the analysis of angular correlations involving internal-conversion electrons are presented. Directional particle parameters are given for the K-, L-, and M-subshells and for the total L- and M-shells. Polarization particle parameters are given for the K-shell. The calculations were performed for the four lowest electric and magnetic multipoles for all Z-values from 30 to 103 and for electron energies varying from 6 to 1500 keV above threshold. Only the particle parameters of lower rank are given. Those of higher rank can be found from the recurrence relations presented. A table of F-coefficients is included. (auth)

4085 FINE STRUCTURE OF THE ANALOGUE RESONANCES. Urin, M. G. (Moscow Physical Engineering Inst.); Zaretskii, D. F. Phys. Lett., 28B: 10-11(Oct. 28, 1968).

The description of the (p,p') and (pn) resonance reactions accompanied by the excitation of analogue states is given. On the basis of the "internal" Coulomb mixing assumption, the expressions for corresponding cross sections averaged over the fine structure components are obtained. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstract 2460.

4086 (ACNP-68505-C) LA CROSSE BOILING WATER REACTOR OPERATING MANUAL. VOLUME III. TURBINE GENERATOR SYSTEMS. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Aug. 1968. Contract AT(11-1)-850. 278p. Dep. CFSTI.

Included are system descriptions, components descriptions, operating procedures, system diagrams, pump curves, valve checklists, and other pertinent information required for operation of the systems and equipment installed in the LACBWR Generator Plant and for the training of LACBWR personnel. Described in separate sections are: steam turbine; 60 MW generator; circulating water system; turbine oil and H_2 seal oil system; H_2 and CO_2 system; gland steam sealing system; condenser vacuum system; gaseous waste disposal system; condensate and feedwater system; full-flow condensate demineralizer system; and reactor feedwater pumps. (H.D.R.)

4087 (DOCKET-50206-4) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Final Engineering Report and Safety Analysis, Amendment 8, Vol. 1. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Nov. 29, 1965. 330p. Dep. CFSTI.

Information on San Onofre Power Reactor is given under the following broad topics: Introduction; Summary; Site Description; and Plant Facilities-Reactor Cycle. (D.C.C.)

4088 (DOCKET-50206-5) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Final Engineering Report and Safety Analysis, Amendment 8, Vol. 2. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Nov. 29, 1965. 221p. Dep. CFSTI.

Information on San Onofre Power Reactor is given under the following broad topics: Plant Facilities-Turbine Cycle; Plant Facilities-Safety Systems; and Instrumentation and Control Systems. (D.C.C.)

4089 (DOCKET-50206-6) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Final Engineering Report and Safety Analysis, Amendment 8, Vol. 3. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Nov. 29, 1965. 267p. Dep. CFSTI.

Information on San Onofre Power Reactor is given under the following broad topics: Administration; Research and Development; Reactivity Fault Analyses; Mechanical Malfunction Analyses; Plant Behavior; Chemical Reactions; Fission Product Inventory; Hypothetical Accident; Environmental Consequences; and Conclusions. Appendices contain information on: general assumptions for accident analysis, and drawing symbols and abbreviations. (D.C.C.)

4090 (DOCKET-50206-7) [SAN ONOFRE NUCLEAR GENERATING STATION], UNIT 1. Application for Construction Permit and for License, Part A. (Southern California Edison Co., Camp Pendleton, Calif.). Feb. 4, 1963. 113p. Dep. CFSTI.

Financial data on the owners of the San Onofre Power Reactor are given in support of the application for construction permit and operating license. The 1961 Annual Report for the Southern California Edison Company is included. (D.C.C.)

4091 (DOCKET-50206-8) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 1. (Southern California Edison Co., Camp Pendleton, Calif.). May 10, 1963. 65p. Dep. CFSTI.

Hazards analysis for the San Onofre Power Reactor is presented in support of the application for construction permit and operating license. Topics discussed include: site, research and development, safety systems, containment, accident analysis, fuel and core assembly, and control room. Appendix includes site map and aerial photo. (D.C.C.)

4092 (DOCKET-50206-9) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 2. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). July 3, 1963. 88p. Dep. CFSTI.

Financial data on the owners of the San Onofre Power Reactor are given in support of the application for construction permit and operating license. The 1962 Annual Report for the Southern California Edison Company is included. (D.C.C.)

4093 (DOCKET-50206-10) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 3. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Aug. 27, 1963. 104p. Dep. CFSTI.

Information is given on: seismic criteria for reactor design; containment design; environmental monitoring program; and safety injection system criteria. (D.C.C.)

4094 (DOCKET-50206-11) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 4. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Sept. 30, 1963. 29p. Dep. CFSTI.

Information is given on: financial qualifications of Bechtel Corporation; seismic criteria; containment tests; rain-out hazards analysis; and seismic response spectra. (D.C.C.)

4095 (DOCKET-50206-12) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 5. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Oct. 11, 1963. 14p. Dep. CFSTI.

Information is given on seismic design criteria for the San Onofre Power Reactor. (D.C.C.)

4096 (DOCKET-50206-13) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 6. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). May 4, 1964. 13p. Dep. CFSTI.

Information is given on the estimated nuclear materials management schedule for the San Onofre Power Reactor. (D.C.C.)

4097 (DOCKET-50206-14) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. [Preliminary Safety Analysis Report], Amendment 7. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). May 21, 1964. 10p. Dep. CFSTI.

Revisions are presented for the wording of the application for the San Onofre Power Reactor construction and license. (D.C.C.)

4098 (DOCKET-50206-15) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Application for Provisional Operating License, Amendment 8. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Nov. 29, 1965. 115p. Dep. CFSTI.

Financial data on the owners of the San Onofre Power Reactor are given in support of the application for provisional operating license. The 1964 Annual Report for the Southern California Edison Company is included. (D.C.C.)

4099 (DOCKET-50206-16) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Final Engineering Report and Safety Analysis, Amendment 13, Suppl. 3. (Southern California Edison Co., Camp Pendleton, Calif. San Diego Gas and Electric Co., Calif.). Sept. 23, 1966. 14p. Dep. CFSTI.

Information is presented on the following topics: control rod insertion and withdrawal sequences; refueling accident; operational reactivity parameters; coolant loss safety systems; single auxiliary feed water pump operation; and feasibility of San Clemente evacuation. (D.C.C.)

4100 (DOCKET-50244-7) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Final Facility Description and Safety Analysis Report, Amendment 10, Suppl. 5, Exhibit D-9. (Rochester Gas and Electric Corp., N. Y.). Oct. 23, 1968. 505p. Dep. CFSTI.

Seismic classifications of reactor buildings and structures are described. Calculations of expected gaseous discharge from accidents are presented. Revised core parameters are described. Evaluation of the core barrel and thermal shield is presented. The UO_2 fuel forms and cycle performance are analyzed. The control rod drives are described. An non-destructive inspection method for the coolant system is described. Cooling system support structures are described. Penetrations in the reinforced concrete containment vessel for pipes and electrical conductors are described. The cooling system flow controls are described. Preoperational testing is discussed. Design criteria for coolant loss accidents are listed. Environmental protection equipment is described. Containment spray and charcoal filtration systems are described. Control and communication systems are presented. Emergency power equipment is described. The effects of borated

water on reactor metals are analyzed. Decontamination methods and procedures are described. The ventilation systems for the auxiliary building and control room are described. Waste handling procedures are described. Core loading is described. Testing programs and procedures are listed. The effects of steam pipe rupture are analyzed. Core cooling calculations are presented. (D.C.C.)

4101 (DOCKET-50247-1) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Final Facility Description and Safety Analysis Report, Amendment 9, Vol. 1, Exhibit B-8. (Consolidated Edison Co. of New York, Inc., New York). Oct. 15, 1968. 482p. Dep. CFSTI.

Final design information on Indian Point Power Reactor, Unit 2, is given under the following topics: Introduction and Summary; Site and Environment; and Reactor. (M.L.S.)

4102 (DOCKET-50247-2) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Final Facility Description and Safety Analysis Report, Amendment 9, Vol. 2, Exhibit B-8. (Consolidated Edison Co. of New York, Inc., New York). Oct. 15, 1968. 429p. Dep. CFSTI.

Final design information on Indian Point Power Reactor, Unit 2, is given under the following topics: Reactor Coolant System; Containment System; and Engineered Safety Features including the safety injection system, containment spray systems, containment air recirculation cooling and filtration system, isolation valve seal water system, containment penetration and weld channel pressurization system, and leakage detection systems. (M.L.S.)

4103 (DOCKET-50247-3) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Final Facility Description and Safety Analysis Report, Amendment 9, Vol. 3, Exhibit B-8. (Consolidated Edison Co. of New York, Inc., New York). Oct. 15, 1968. 447p. Dep. CFSTI.

Final design information on Indian Point Power Reactor, Unit 2, is given on the following topics: Instrumentation and Control; Electrical Systems; Auxiliary and Emergency Systems; Steam and Power Conversion System; and Waste Disposal and Radiation Protection System. (M.L.S.)

4104 (DOCKET-50247-4) INDIAN POINT NUCLEAR GENERATING UNIT NO. 2. Final Facility Description and Safety Analysis Report, Amendment 9, Vol. 4, Exhibit B-8. (Consolidated Edison Co. of New York, Inc., New York). Oct. 15, 1968. 453p. Dep. CFSTI.

Final design information on Indian Point Power Reactor, Unit 2, is given on the following topics: Conduct of Operations; Initial Tests and Operations; and Safety Analysis including core and coolant boundary protection, standby safety features, and primary system pipe rupture. Appendices contain: design criteria for structures and equipment, quality control program, and the Containment Linear Stress Analysis Report. (M.L.S.)

4105 (DOCKET-50254-10) QUAD-CITIES STATION, UNITS 1 AND 2. Safety Analysis Report, Amendment 7, Vol. 1. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). Aug. 30, 1968. 450p. (DOCKET-50265-7). Dep. CFSTI.

Information on Units 1 and 2 of Quad-Cites is presented in the following broad categories: Site; Reactor Core and Internals; Reactor Coolant System; Containment Systems; Engineered Safeguards. The design of each unit, the safety systems, and the accident analyses are described for operation at a thermal output of 2511 MW, equivalent to 809 MW(e). The original reference design analysis was for a power level of 2255 MW(t), equivalent to 715 MW(e). (H.D.R.)

4106 (DOCKET-50254-11) QUAD-CITIES STATION, UNITS 1 AND 2. Safety Analysis Report, Amendment 7, Vol. 2. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). [Aug. 30, 1968]. 470p. (DOCKET-50265-8). Dep. CFSTI.

Design aspects of the Quad-Cities Units 1 and 2 are presented under the following broad topics: Control and Instrumentation; Electrical System; Radioactive Waste Systems; Reactor Auxiliaries; Turbine and Condensate Systems; Structures and Shielding; Conduct of Operation; Safety Analysis. Appendices describe and evaluate the site meteorology and limits, conformance to design criteria, primary containment fabrication report, and the reactor pressure vessel reports. (H.D.R.)

4107 (DOCKET-50254-12) QUAD-CITIES STATION, UNITS 1 AND 2. TECHNICAL SPECIFICATIONS. [Safety Analysis Report, Amendment 7, Vol. 3]. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). [Aug. 30, 1968]. 93p. (DOCKET-50265-9). Dep. CFSTI.

Included are proposed technical specifications intended for incorporation into the operating license for Quad-Cities Units 1 and 2. The specifications and their basis are presented for: core thermal hydraulic safety limit; coolant system pressure safety limit; reactor protection system; safety instrumentation; reactivity control; emergency core cooling system; coolant system operation; containment systems; effluent discharges; auxiliary power system; refueling; and administrative controls. (H.D.R.)

4108 (DOCKET-50263-1) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 9, Vol. 1. (Northern States Power Co., Minneapolis, Minn.). Oct. 21, 1968. 343p. Dep. CFSTI.

Information on Monticello Power Reactor, Unit 1 is given under the following broad topics: Introduction and Summary, Plant Site and Environs; Reactor Core; and Reactor Coolant System. (M.L.S.)

4109 (DOCKET-50263-2) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 9, Vol. 2. (Northern States Power Co., Minneapolis, Minn.). Oct. 21, 1968. 434p. Dep. CFSTI.

Information on Monticello Power Reactor, Unit 1 is given under the following broad topics: Plant Containment Systems; Engineered Safeguards including Emergency Core Cooling Systems (ECCS), main steam line flow restrictor, control rod velocity limiters, control rod drive housing supports, and standby liquid control system; Plant Instrumentation and Control Systems; and Plant Electrical Systems. (M.L.S.)

4110 (DOCKET-50263-3) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 9, Vol. 3. (Northern States Power Co., Minneapolis, Minn.). Oct. 21, 1968. 327p. Dep. CFSTI.

Information on Monticello Power Reactor, Unit 1 is given under the following topics: Plant Radioactive Waste Control Systems; Reactor Auxiliary Systems; Plant Power Conversion Systems; Plant Structures and Shielding; Plant Operations; and Safety and Accident Analyses including abnormal operational transients, design basis accident analysis, and a description of analytical methods. (M.L.S.)

4111 (DOCKET-50263-4) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Final Safety Analysis Report, Amendment 9, Vol. 4. (Northern States Power Co., Minneapolis, Minn.). Oct. 21, 1968. 350p. Dep. CFSTI.

Information on Monticello Power Reactor, Unit 1 is given on: seismic design criteria, plant quality assurance programs, and plant comparative evaluation with the proposed AEC 70 Design Criteria. (M.L.S.)

4112 (DOCKET-50263-5) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Facility Description and Safety Analysis Report, Part A, Vol. 1. (Northern States Power Co., Minneapolis, Minn.). Aug. 8, 1966. 289p. Dep. CFSTI.

Information on Monticello Power Reactor is given under the following broad topics: Introduction and Summary; Site and Environment; Reactor; Reactor Coolant System; and Containment Systems. (D.C.C.)

4113 (DOCKET-50263-6) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Facility Description and Safety Analysis Report, Part A, Vol. 2. (Northern States Power Co., Minneapolis, Minn.). Aug. 8, 1966. 202p. Dep. CFSTI.

Information on Monticello Power Reactor is given under the following broad topics: Introduction and Summary; Site and Environment; Reactor; Reactor Coolant System; Containment Systems; Additional Engineered Safeguards; Plant Control and Instrumentation; Electrical Systems; Radioactive Waste Control; Reactor Auxiliary Services and Systems; Power Conversion System; Conduct of Operations; and Safety Analysis. (D.C.C.)

4114 (DOCKET-50263-7) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Facility Description and Safety Analysis Report, Part B, Vol. 1. (Northern States Power Co., Minneapolis, Minn.). Aug. 8, 1966. 323p. Dep. CFSTI.

Information on Monticello Power Reactor is given under the following broad topics: Containment Systems; Additional Engineered Safeguards; Plant Control and Instrumentation; Electrical Systems; Radioactive Waste Control; Reactor Auxiliary Services and Systems; Power Conversion System; Conduct of Operations; and Safety Analysis. (D.C.C.)

4115 (DOCKET-50263–8) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. Facility Description and Safety Analysis Report, Part B, Vol. 2. (Northern States Power Co., Minneapolis, Minn.). Aug. 8, 1966. 121p. Dep. CFSTI.

Appendices presented contain information on the Monticello Power Reactor under the following topics: reliability analysis of reactor protection system; control rod drive system description and analysis; jet pump development; core spray test program; containment fission product retention capability; and site assembly of the pressure vessel. (D.C.C.)

4116 (DOCKET-50263–9) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 2. (Northern States Power Co., Minneapolis, Minn.). Nov. 18, 1966. 454p. Dep. CFSTI.

Revised information is given on: feasibility of shipping shop-assembled vessel to site; pressure vessel design analysis; pressure vessel fabrication and assembly; quality control procedures; and field organization. (D.C.C.)

4117 (DOCKET-50263–10) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 3. (Northern States Power Co., Minneapolis, Minn.). Dec. 29, 1966. 93p. Dep. CFSTI.

Revised information is given on: design parameters and characteristics of primary containment; core spray systems; and standby generator system. (D.C.C.)

4118 (DOCKET-50263–11) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 4. (Northern States Power Co., Minneapolis, Minn.). Jan. 11, 1967. 215p. Dep. CFSTI.

Revised information is given on: primary containment design parameters and characteristics; accident safety analysis; core spray system; siting and environment safety; and waste disposal. (D.C.C.)

4119 (DOCKET-50263–12) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 5. (Northern States Power Co., Minneapolis, Minn.). Jan. 24, 1967. 9p. Dep. CFSTI.

Information is presented on the field assembly procedures for pressure vessels. (D.C.C.)

4120 (DOCKET-50263–13) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 6. (Northern States Power Co., Minneapolis, Minn.). Mar. 8, 1967. 138p. Dep. CFSTI.

Revised information is given on: materials testing and inspection of pressure vessel; emergency cooling system; siting and environment; and buildings and structures. (D.C.C.)

4121 (DOCKET-50263–14) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 8. (Northern States Power Co., Minneapolis, Minn.). Mar. 31, 1967. 8p. Dep. CFSTI.

Information on Mississippi flow characteristics and the effects of Monticello Power Reactor pollution is presented. (D.C.C.)

4122 (DOCKET-50263–15) MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1. [Facility Description and Safety Analysis Report], Amendment 10. (Northern States Power Co., Minneapolis, Minn.). Nov. 12, 1968. 93p. Dep. CFSTI.

Information is presented on: reactor parameters for full power levels; stack release limit calculations; and pre-operational and startup tests. (D.C.C.)

4123 (DOCKET-50263–16) [MONTICELLO NUCLEAR GENERATING PLANT, MONTICELLO, MINNESOTA, UNIT 1]. REPORT ON REACTOR SITE FOR NORTHERN STATES POWER COMPANY. (Atomic Energy Commission, Washington, D. C. Advisory Committee on Reactor Safeguards). May 11, 1966. 2p. Dep. CFSTI.

Information is presented on problems related to the proposed Monticello Power Reactor site. (D.C.C.)

4124 (DOCKET-50263–17) MONTICELLO NUCLEAR GENERATING PLANT, [MONTICELLO, MINNESOTA,] UNIT 1. ACRS Letter. (Atomic Energy Commission, Washington, D. C. Advisory Committee on Reactor Safeguards). Apr. 13, 1967. 3p. Dep. CFSTI.

Information is presented concerning emergency core cooling and power facilities for the Monticello Power Reactor. (D.C.C.)

4125 (DOCKET-50286–6) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 4, Suppl. 4, Exhibit B-4. (Consolidated Edison Co. of New York, Inc., New York). Nov. 4, 1968. 96p. Dep. CFSTI.

A complete list of Class II structures and systems and combined structures for Indian Point Power Reactor, Unit 3, is given. Design criteria for tornado loadings are given. Normal operating and transient accident thermal gradients used as containment design criteria are described; data are shown graphically. Design details of the containment vessel liner are discussed; design of liner anchorages is detailed. An analysis of containment penetrations and large openings is given. Design requirements and performance specifications for the polyvinylchloride insulation for the containment vessel are given. Structural testing procedures are outlined. (M.L.S.)

4126 (DOCKET-50286–7) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 5, Suppl. 5, Exhibit B-5. (Consolidated Edison Co. of New York, Inc., New York). Nov. 4, 1968. 133p. Dep. CFSTI.

Additional information on Indian Point Power Reactor, Unit 3, is given on the following general subjects: modified Emergency Core Cooling System, primary auxiliary building description, conduct of operations and initial testing program, quality control program, hydrogen generation and recombiner, containment spray research and development, off-site dose evaluation, seismic stress limit analyses for the containment system, and site power supply systems. (M.L.S.)

4127 (DOCKET-50286–8) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 3, Suppl. 3, Exhibit B-3. (Consolidated Edison Co. of New York, Inc., New York). Oct. 18, 1968. 13p. Dep. CFSTI.

Design calculations and analytical procedures for stress analyses of the containment structure for the Indian Point Power Reactor, Unit 3, are detailed. (M.L.S.)

4128 (DOCKET-50296–3) BROWNS FERRY NUCLEAR POWER STATION, UNIT NO. 3, LIMESTONE COUNTY, ALABAMA. Safety Evaluation. (Tennessee Valley Authority, [Knoxville]). June 6, 1968. 107p. Dep. CFSTI.

The technical safety review of the proposed Browns Ferry Unit 3 is principally concerned with plant features that differ from those of the previously reviewed Units 1 and 2. Appendices include the safety analysis for Units 1 and 2, correspondence between applicant and contractor, and the ACRS regulatory review of Unit 3. (H.D.R.)

4129 (DOCKET-50315–11) DONALD C. COOK NUCLEAR PLANT. [Preliminary Safety Analysis Report], Amendment 7. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Oct. 21, 1968. 115p. (DOCKET-50316–11). Dep. CFSTI.

Meteorologic and seismologic data for the Donald C. Cook Power Reactor, Units 1 and 2, are analysed. Compatibility of safety related equipment and post-accident environments is considered. Likelihood and consequences of turbine-generator failure are evaluated; calculations of off-site doses are tabulated. The pre-operational environmental monitoring program is described. Surveillance of the containment vessel liner for possible corrosion is discussed. Proposed integrated leak rate with and without the ice containment system is described. (M.L.S.)

4130 (DOCKET-50315–12) DONALD C. COOK NUCLEAR PLANT. [Preliminary Safety Analysis Report], Amendment 8. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Oct. 23, 1968. 25p. (DOCKET-50316–12). Dep. CFSTI.

Effects of nitrogen gas from the exhausted accumulators on core cooling for the Donald C. Cook Power Reactor, Units 1 and 2, are evaluated. This includes a summary of Emergency Core Cooling Systems (ECCS) design provisions, calculations to show that the loss-of-coolant accident design criteria are satisfied, and calculations of metal–water reaction effects. (M.L.S.)

4131 (DOCKET-50319–4) BELL STATION. Preliminary Safety Analysis Report, Amendment 1, Part A. (New York State Electric and Gas Corp., Binghamton). Oct. 24, 1968. 539p. Dep. CFSTI.

A summary of research and development programs for the Bell Power Reactor is given. In-service inspection of the cooling system is discussed. The quality assurance program is detailed. A detailed analysis of accidental release of stored liquid radioactive waste is given. An exclusion area for the Bell Power

Reactor is defined; off-site dose calculations are discussed. Reconcentration factors for radionuclides in liquid effluents which will be released into Cayuga Lake are tabulated. Information on subsurface soil and foundation conditions is detailed. Effects of increase of feedwater temperature are discussed. The reactor internals which must maintain post-accident integrity for safe shutdown are described; safety margins are given. Methods used for seismic analysis of Class I structures are described. Criterion 35 of the 70 General Design Criteria is compared in detail to the Bell Station design. Containment systems and structures design are detailed. Emergency Core Cooling System (ECCS) design for accommodation of single failure in the torus or ECCS pump suction lines is described. Instrumentation for and initiation of engineered safeguards is described; control rod positioning readout and display are detailed. Interlock actuation and bypass and logic for reactor trip circuits are discussed. A failure mode analysis on the 250 volt d-c system is given; the off-site power supply is described. Proposed operations and operating procedures are discussed. Plans for leak checking the primary and ECCS systems are outlined. (M.L.S.)

4132 (DOCKET-50319-5) BELL STATION. Preliminary Safety Analysis Report, Amendment 1, Part B. (New York State Electric and Gas Corp., Binghamton). Oct. 25, 1968. 152p. Dep. CFSTI.

Revised or additional information is given for all sections of the original Preliminary Safety Analysis Report for Bell Power Reactor. (M.L.S.)

4133 (DOCKET-50320-7) OYSTER CREEK NUCLEAR STATION, UNIT NO. 2. [Preliminary Safety Analysis Report], Amendment 4. (Jersey Central Power and Light Co., Morristown, N. J.). Oct. 31, 1968. 655p. Dep. CFSTI.

Revised or additional information of Oyster Creek Power Reactor, Unit 2 is given on the following broad topics: Reactor; Containment Systems including quality control, inspection, and testing; Engineered Safeguards; Instrumentation and Control Systems; Electrical Systems; Auxiliary and Emergency Systems; Steam and Power Conversion Systems; and Radioactive Waste and Radiation Protection. Supplementary boring and geophysical data for the Oyster Creek site are included. (M.L.S.)

4134 (DOCKET-50327-1) SEQUOYAH NUCLEAR PLANT, [UNITS 1 AND 2]. Preliminary Safety Analysis Report, Vol. 1. (Tennessee Valley Authority, [Knoxville]). Oct. 15, 1968. 446p. (DOCKET-50328-1). Dep. CFSTI.

Information on Sequoyah Power Reactor is given under the following broad topics: Introduction and Summary; Site and Environment; Reactor; and Reactor Coolant System. (D.C.C.)

4135 (DOCKET-50327-2) SEQUOYAH NUCLEAR PLANT, [UNITS 1 AND 2]. Preliminary Safety Analysis Report, Vol. 2. (Tennessee Valley Authority, [Knoxville]). Oct. 15, 1968. 477p. (DOCKET-50328-2). Dep. CFSTI.

Information of Sequoyah Power Reactor is given under the following broad topics: Containment System; Engineered Safety Features; Plant Instrumentation and Control; Electrical Systems; and Auxiliary and Emergency Systems. (D.C.C.)

4136 (DOCKET-50327-3) SEQUOYAH NUCLEAR PLANT, [UNITS 1 AND 2]. Preliminary Safety Analysis Report, Vol. 3. (Tennessee Valley Authority, [Knoxville]). Oct. 15, 1968. 398p. (DOCKET-50328-3). Dep. CFSTI.

Information on Sequoyah Power Reactor is given under the following broad topics: Steam and Power Conversion Systems; Waste Disposal and Radiation Protection; Conduct of Operations; Initial Tests and Operations; Safety Evaluation; and Technical Specifications. Appendices contain information on: quality control programs, seismic design criteria for structures and equipment, function evaluation of components shared by the two units, and general design criteria. (D.C.C.)

4137 (DOCKET-50331-1) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Vol. 1. (Iowa Electric Light and Power Co., Cedar Rapids). Nov. 4, 1968. 650p. Dep. CFSTI.

Information on Duane Arnold Power Reactor is given under the following broad topics: Introduction and Summary; Site and Environment; and Reactor. (D.C.C.)

4138 (DOCKET-50331-2) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Vol. 2. (Iowa Electric Light and Power Co., Cedar Rapids). Nov. 1, 1968. 389p. Dep. CFSTI.

Information on Duane Arnold Power Reactor is given under the following broad topics: Reactor Coolant System; Containment; and Core Standby Cooling Systems. (D.C.C.)

4139 (DOCKET-50331-3) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Vol. 3. (Iowa Electric Light and Power Co., Cedar Rapids). Nov. 4, 1968. 457p. Dep. CFSTI.

Information on Duane Arnold Power Reactor is given under the following broad topic: Control and Instrumentation. (D.C.C.)

4140 (DOCKET-50331-4) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Vol. 4. (Iowa Electric Light and Power Co., Cedar Rapids). Nov. 1, 1968. 348p. Dep. CFSTI.

Information on Duane Arnold Power Reactor is given under the following broad topics: Electrical Power Systems; Radioactive Waste Systems; Auxiliary Systems; Power Conversion Systems; Station Structures and Shielding; and Conduct of Operations. (D.C.C.)

4141 (DOCKET-50331-5) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Vol. 5. (Iowa Electric Light and Power Co., Cedar Rapids). Nov. 1, 1968. 323p. Dep. CFSTI.

Information on Duane Arnold Power Reactor is given under the following broad topics: Plant Safety Analysis. The Appendix contains information on: pressure integrity of piping and equipment pressure parts. (D.C.C.)

4142 (DOCKET-50331-6) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Vol. 6. (Iowa Electric Light and Power Co., Cedar Rapids). Nov. 1, 1968. 318p. Dep. CFSTI.

Appendices contain information on: outline of proposed technical specifications, loading criteria, quality control system, stack release limit calculations, site assembly of the reactor pressure vessel, field explorations and laboratory tests, and maximum probable flood. (D.C.C.)

4143 (GAMD-7901) PEACH BOTTOM SHIELDING SURVEYS: RESULTS OF POSTCONSTRUCTION R AND D TEST PROCEDURES DO-1, DO-3, AND GO-3. Engholm, B. A. (Gulf General Atomic, Inc., San Diego, Calif.). Nov. 14, 1967. Contract AT(04-3)-314. 34p. Dep. CFSTI.

Results of shielding tests for Peach Bottom Power Reactor, Unit 1 at 0%, 30%, and 100% power are given. Data are tabulated; procedures are included. (M.L.S.)

4144 (GAMD-8625) PSC REGION I FLOW MODEL (SERIES 2) TEST REPORT. Walker, W. E. (Gulf General Atomic, Inc., San Diego, Calif.). July 8, 1968. Contract AT(04-3)-633. 90p. Dep. CFSTI.

The experimental rig used simulation of coolant gas flow in the Fort St. Vrain Power Reactor, Unit 1 core and steam generator is described; rig drawings are included. Gas velocity profiles and temperature contour measurements are discussed; data are given in tabular and graphic form. (M.L.S.)

4145 (GEAP-5667) ZIRCALOY-CLAD UO_2 FUEL ROD EVALUATION PROGRAM. Quarterly Progress Report No. 3, May-July 1968. Megerth, F. H. (comp.) (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Aug. 1968. Contract AT(04-3)-189. 28p. Dep. CFSTI.

Fuel element performance for the Dresden Power Reactor Unit 1 Assembly SA-1 is analyzed. Crud and ZrO_2 depositions on the Zircaloy 2-clad UO_2 fuel elements are described and illustrated. Fuel element isotopic compositions are presented. (D.C.C.)

4146 (NP-17671) ATOMIC POWER AND OIL INDUSTRY. (Japan Atomic Industrial Forum, Inc., Tokyo). Mar. 1968. 19p. Dep.

The economic influences that nuclear power may have on the oil industry are described. The oil considered is limited to the heavy oil for use by the electric power industry. Supply-and-demand projections through 1995 are presented. (D.C.C.)

4147 (WAPD-TM-766) ISOTOPIC ANALYSIS OF NATURAL UO_2 FUEL IRRADIATED TO 22,000 MWD/MTU: THEORY VERSUS EXPERIMENT. Stachew, J. C. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Aug. 1968. Contract AT-11-1-GEN-14. 81p. Dep. CFSTI.

The U and Pu isotopic distributions of 45 irradiated fuel rods of natural UO_2 are compared to theoretical predictions made using three-dimensional P-1 neutron diffusion techniques. The calculational technique is somewhat unique in that normalization to experimental results is made only by use of the total core energy output and measured critical rod bank heights. This is in contrast to normalizing each individual fuel rod burnup to the experimental value and then investigating resultant isotopic distributions in the rod. The comparison indicates good agreement but identifies the need for a spatial spectrum variation of the ^{238}U epithermal resonance absorption cross section and im-

proved time dependence of the ^{238}U and ^{239}Pu cross sections. (auth)

4148 REQUIREMENTS FOR RECYCLE FUEL FROM THE PCUT NUCLEAR FUEL REPROCESSING AND REFABRICATION FACILITY. Orsenigo, Giuseppe (CNEN, Rome); Schafer, Alex. Trans. Amer. Nucl. Soc., 11: 445-6(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4149 NEW TYPE OF REACTOR CONTAINMENT OF PRESTRESSED CONCRETE. Hojgaard, E. (ASEA, Atomkraftyran, Vasteras, Sweden); Nilsson, L. B.; Kallero, K. E. Trans. Amer. Nucl. Soc., 11: 643(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4150 RECENT OPERATING EXPERIENCE AT THE PEACH BOTTOM ATOMIC POWER STATION. Kantor, M. E. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 647-8(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4151 AVR INITIAL OPERATING EXPERIENCE. Hantke, H. J. (Brown Boveri/Krupp, Julich, Ger.). Trans. Amer. Nucl. Soc., 11: 646(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4152 POWER REACTOR SITING IN CANADA. Laurence, G. C. (Atomic Energy Control Board of Canada, Ottawa, Ont.). Trans. Amer. Nucl. Soc., 11: 613(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4153 TREATMENT GIVEN TO SOME SPECIFIC TECHNICAL PROBLEMS IN SAFETY REVIEWS IN EUROPE. Vinck, W. (Commission of the European Communities, Brussels); Maurer, H.; Karwat, H. Trans. Amer. Nucl. Soc., 11: 665-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4154 AN ANALYSIS OF REACTOR LICENSING SUPPLEMENTARY QUESTION "REQUIREMENTS." Baskin, Kenneth P.; Sesonske, Alexander (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc., 11: 666(Nov. 1968).

4155 PROBLEMS OF POWER REACTOR SITING IN JAPAN. Mukaibo, Takashi (Tokyo Univ.). Trans. Amer. Nucl. Soc., 11: 613(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4156 ASPECTS ON THE SITING OF THE DUAL-PURPOSE VARTAN NUCLEAR POWER PLANT IN METROPOLITAN STOCKHOLM. Ryman, Jan E. (Stockholm Electricity Board). Trans. Amer. Nucl. Soc., 11: 614-15(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4157 PROBLEMS AND CONSIDERATIONS OF U.S. REACTOR SITING. Case, Edson G. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 615(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4158 THE CANDU REACTOR AND CANADA'S ECONOMY. Merlin, H. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Eng. J. (Montreal), 10: 19-27(Oct. 1968). (AECL-3083).
The cost difference between coal-fired and CANDU nuclear power stations is compared and projected to the year 2000. Forecasts are presented for electricity demand and generation in nuclear stations together with estimates of annual and cumulative savings in generating electricity from CANDU units. (auth)

4159 THE ASEA-REACTOR AT RINGHALS. Tek. Tidskr., 37: 743-5(1968). (In Swedish).
The reactor for the Swedish State Power Board nuclear power station at Ringhals south of Gothenburg is briefly described. It is a boiling water reactor with 2,270 MW(t) and 750 MW(e). It is designed by Allmanna Svenska Elektriska Aktiebolaget. The main contractor is the newly formed company AB ASEA-Atom. The principal data for the reactor are: fuel inventory-130 tons UO_2; number of elements-648; core-33,650 mm height and 4,390 mm dia.; burnup-18,600 MWd/ton U (initial core) and 26,800 MWd/ton U (equilibrium core); pressure vessel-21.0 m height and 5.95 m dia.; stream-70 bars and 284.5°C. (Sweden)

4160 CONTROVERSY OVER THERMAL EFFECTS. Thro, Ellen. Nucl. News, 11: No. 12, 49-53(Dec. 1968).
The problems concerning thermal effects on environment caused by power reactor cooling requirements are described. Legal actions for control or regulation are discussed. Possible uses for the wasted heat are considered. (D.C.C.)

4161 PERFORMANCE OF ThO_2-UO_2 FUEL IN INDIAN POINT REACTOR. Baroch, C. J.; Bishop, W. N. (Babcock and Wilcox, Lynchburg, Va.). Trans. Amer. Nucl. Soc., 11: 494(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

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Refer also to abstract 3138.

4162 (AEC-tr-6985) DESIGN OF A FAST-NEUTRON REACTOR EXPERIMENTAL PROTOTYPE OF A POWER PLANT. Vautrey, L. Translation of Paper No. 124 from 7th World Conference on Power, Moscow, 20-24 August 1968. 22p. Dep. CFSTI.
The possibilities of the development of fast-neutron power plants, such as may be envisaged in the framework of the French nuclear program, are briefly discussed. The favorable prospects which may be expected from this type of reactor are recapitulated. The objectives of the reactor prototype Phenix are stated. The essential characteristics of this reactor are given, placing them in their technical or economic context with respect to their more long-range objectives. (auth)

4163 (AEC-tr-6986) INTEGRATION OF NUCLEAR POWER PLANTS INTO THE FRENCH SYSTEM OF ELECTRIC POWER PRODUCTION AND TRANSMISSION. Cabanius, Jean; Janin, Robert. Translated from 7th World Power Conference, Moscow, August 20-24, 1968, Paper No. 228. 12p. Dep. CFSTI.
The effects of the introduction of nuclear plants into the French electric power production system are examined. The range of future costs and changes in the administration of the production system are discussed. Optimum characteristics to be considered for future hydroelectric or thermal plants are investigated. The policy relating to future plant siting and to the transmission system needed is briefly examined. (H.D.R.)

4164 (ANL-7478) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT. (Argonne National Lab., Ill.). July 1968. Contract W-31-109-eng-38. 137p. Dep. CFSTI.
Highlights of project activities are summarized for the month of July 1968. The EBR-II was operated for 543 MWdt to conduct physics experiments related to the exchange of depleted uranium for stainless steel reflector subassemblies. Critical measurements were completed with ZPR-3 assemblies 52D and 52E and loading was started for 52F. Leak testing of ZPPR seal doors was continued, and cabling for experiments was installed. Plutonium and depleted uranium for the initial ZPPR core were received and stored. Nuclear safety studies, including TREAT operations, and chemical separations activities are discussed. 15 references. (H.D.R.)

4165 (GA-7553) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING NOVEMBER 30, 1966. (Gulf General Atomic, Inc., San Diego, Calif.). Feb. 22, 1967. Contract AT(04-3)-167. 166p. Dep. CFSTI.

REACTORS, GAS-COOLED—loading machines for 1000 MW(e) HTGR-type, design parameters of; pressure vessel for 1000 MW(e) HTGR-type, strain analysis for prestressed concrete; fuel reprocessing for 1000 MW(e) HTGR-type, economics of; physics parameters for 1000 MW(e) HTGR-type, one- and two-dimensional multigroup diffusion calculations of, (T); physics measurements for 1000 MW(e) HTGR-type, model analysis of, (E); control elements for 1000 MW(e) HTGR-type, reactivity worth of, (E/T); fuel cycle management for 1000 MW(e) HTGR-type, analysis of optimum
CONCRETES—gamma buildup factors for, effects of source energy on; pressure vessels of prestressed, strain analysis for 1000 MW(e) HTGR-type
REACTOR LOADING MACHINES—design parameters for 1000 MW(e) HTGR-type reactor, updated conceptual
PRESSURE VESSELS—strain analysis for 1000 MW(e) HTGR-type prestressed concrete, effects of pressure on meridional
IRON—gamma buildup factors for, effects of source energy on
GAMMA RADIATION—buildup in concretes and iron, effects of source energy on
FISSION PRODUCTS—release mechanics from 1000 MW(e) HTGR-type reactor core of, analysis of, (T)

THORIUM OXIDES ThO_2—reprocessing of 1000 MW(e) HTGR-type reactor pyrolytic carbon- and zirconium carbide (ZrC)-coated, economics of
THORIUM OXIDES ThO_2—ThO_2–UO_2, reprocessing of 1000 MW(e) HTGR-type reactor pyrolytic carbon- and zirconium carbide (ZrC)-coated, economics of
URANIUM OXIDES UO_2—ThO_2–UO_2, reprocessing of 1000 MW(e) HTGR-type reactor pyrolytic carbon- and zirconium carbide (ZrC)-coated, economics of
REACTOR FUELS—reprocessing of HTGR-type reactor pyrolytic carbon- and zirconium carbide (ZrC)-coated thorium oxide (ThO_2) and thorium oxide (ThO_2)-uranium oxide (UO_2), economics of
REACTOR CONTROL ELEMENTS—reactivity worth of 1000 MW(e) HTGR-type reactor, analysis of, (E/T)
SILICON CARBIDES—coating for 1000 MW(e) HTGR-type reactor fuel, performance of
URANIUM OXIDES UO_2—BeO–UO_2, fuel fission product retention, analysis of HTGR-type reactor
XENON ISOTOPES—retention in beryllium oxide (BeO)–uranium oxide (UO_2) of, analysis of
KRYPTON ISOTOPES—retention in beryllium oxide (BeO)–uranium oxide (UO_2) of, analysis of
GRAPHITE—radiation effects on mechanical properties of, analysis at 400 to 1500°C of neutron
NEUTRONS—effects on mechanical properties of graphite at 400 to 1500°C, analysis of
BERYLLIUM OXIDES—BeO–UO_2, fuel fission product retention, analysis of HTGR-type reactor (D.C.C.)

4166 (GA–7801) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING FEBRUARY 28, 1967. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 20, 1967. Contract AT(04-3)-167. 177p. Dep. CFSTI.

REACTOR, GAS-COOLED—boilers for 1000 MW(e) HTGR-type, updated conceptual design parameters of; fuel reprocessing for 1000 MW(e) HTGR-type, economics of; physics parameters for 1000 MW(e) HTGR-type, calculation of; physics measurements for 1000 MW(e) HTGR-type, model analysis of; control elements for 1000 MW(e) HTGR-type, reactivity worth of, (E/T); fuel cycle management for 1000 MW(e) HTGR-type, analysis of optimum
GRAPHITE—gamma buildup factors for, effects of source energy on; radiation effects on mechanical properties of, analysis at 400 to 1500°C of neutron
BOILERS—physics parameters for 1000 MW(e) HTGR-type reactor, updated conceptual design
PRESSURE VESSELS—tendons for 1000 MW(e) HTGR-type reactor prestressed concrete, failure testing of
IRON, CONCRETES—gamma buildup factors for, effects of source energy on
GAMMA RADIATION—buildup in concretes, graphite, and iron, effects of source energy on
CESIUM-134—concentration in 1000 MW(e) HTGR-type reactor fuel element, effects of burnup on
CESIUM-137, STRONTIUM-90, STRONTIUM-89, BARIUM-140, IODINE-131, CERIUM-144, TANTALUM-182—concentration in 1000 MW(e) HTGR-type reactor fuel element, effects of burnup on
REACTOR CONTROL ELEMENTS—reactivity worth of 1000 MW(e) HTGR-type reactor, analysis of, (E/T)
REACTOR FUELS—cycle management for 1000 MW(e) HTGR-type reactor, analysis of optimum
SILICON CARBIDES—coatings for 1000 MW(e) HTGR-type reactor fuel, performance of
URANIUM OXIDES UO_2—fabrication of particle-type, processes for
URANIUM CARBIDES—fabrication of particle-type, processes for
THORIUM CARBIDES, URANIUM CARBIDES—ThC_2–UC_2, radiation effects on silicon carbide (SiC)-coated particle-type, analysis of fast neutron
NEUTRONS, FAST—effects on silicon carbide (SiC)-coated particle-type thorium carbide (ThC_2)-uranium carbide (UC_2), analysis of
URANIUM OXIDES UO_2, BERYLLIUM OXIDES—BeO–UO_2, fuel of, performance of 1000 MW(e) HTGR-type reactor
NEUTRONS—effects on mechanical properties of graphite at 400 to 1500°C, analysis of (D.C.C.)

4167 (GA–7939) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(E) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1967. (Gulf General Atomic, Inc., San Diego, Calif.). May 5, 1967. Contract AT(04-3)-633. 143p. Dep. CFSTI.

FORT ST. VRAIN POWER REACTOR, UNIT 1—pressure vessel for, strain analysis for prestressed concrete; fuel cycle for, analysis of optimum; core configuration for, analysis of optimum; fuel development for, analysis of optimum coated-particle
REACTOR FUELS—cycle for Fort St. Vrain Power Reactor, Unit 1 thorium carbide (ThC_2)–uranium carbide (UC_2), analysis of optimum; development of optimum coated-particle, for Fort St. Vrain Power Reactor, Unit 1
PRESSURE VESSELS—strain analysis for Fort St. Vrain Power Reactor, Unit 1 prestressed concrete, description of
CONCRETES—mechanical properties of, prestressed effects of time and temperature on
URANIUM CARBIDES—ThC_2–UC_2, fuel cycle for Fort St. Vrain Power Reactor, Unit 1, analysis of optimum
THORIUM CARBIDES—ThC_2–UC_2, fuel cycle for Fort St. Vrain Power Reactor, Unit 1, analysis of optimum
BEARINGS—pressure profiles for Fort St. Vrain Power Reactor, Unit 1, blower hybrid thrust, analysis of
BURNABLE POISONS—reactivity effects in Fort St. Vrain Power Reactor, Unit 1, calculation of
REACTIVITY—burnable poison effect, on Fort St. Vrain Power Reactor, Unit 1, calculation of (D.C.C.)

4168 (GA–7981) HTGR BASE PROGRAM. Quarterly Progress Report for the Period Ending May 31, 1967. (Gulf General Atomic, Inc., San Diego, Calif.). Sept. 29, 1967. Contract AT(04-3)-167. 204p. Dep. CFSTI.

REACTORS, GAS-COOLED—physics parameters for 1000 MW(e) HTGR-type, updated conceptual design; pressure vessel for 1000 MW(e) HTGR-type, strain analysis for prestressed concrete; fuel reprocessing for 1000 MW(e) HTGR-type, economics of; physics parameters for 1000 MW(e) HTGR-type, calculation of; physics measurements for 1000 MW(e) HTGR-type, model analysis of; control elements for 1000 MW(e) HTGR-type, reactivity worth of, (E/T); fuel cycle management for 1000 MW(e) HTGR-type, analysis of optimum
GRAPHITE—gamma buildup factors for, effects of source energy on; radiation effects on mechanical properties of, analysis of 300 to 1500°C of neutron
REACTOR FUELS—binders for particle-type thorium oxide (ThO_2)-uranium oxide (UO_2), performance of multiple resin; cycle management for 1000 MW(e) HTGR-type reactor, analysis of optimum
PRESSURE VESSELS—strain analysis for 1000 MW(e) HTGR-type reactor prestressed concrete, description of
IRON, CONCRETES—gamma buildup factors for, effects of source energy on
GAMMA RADIATION—buildup in concretes, graphite, and iron, effects of source energy on
FISSION PRODUCTS—diffusion in pyrolytic carbon of, analysis
CARBON—diffusion of fission products in pyrolytic, analysis of
RESINS—use as binders in reactor fuels
THORIUM OXIDES ThO_2—ThO_2–UO_2, oxidation of pyrolytic carbon-coated particle-type, effects of temperature on
URANIUM OXIDES UO_2—ThO_2–UO_2, oxidation of pyrolytic carbon-coated particle-type, effects of temperature on
REACTOR CONTROL ELEMENTS—reactivity worth of 1000 MW(e) HTGR-type reactor, analysis of, (E/T)
SILICON CARBIDES—coating for 1000 MW(e) HTGR-type reactor fuel, performance of
NEUTRONS—effects on mechanical properties of graphite at 300 to 1500°C, analysis of (D.C.C.)

4169 (GA–8038) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending June 30, 1967. (Gulf General Atomic, Inc., San Diego, Calif.). July 28, 1967. Contract AT(04-3)-633. 229p. Dep. CFSTI.

FORT ST. VRAIN POWER REACTOR, UNIT 1—pressure vessel for, strain analysis for prestressed concrete; fuel cycle for, analysis of optimum; core configuration for, analysis of optimum; control elements for, reactivity worth of; fuel development for, analysis of optimum coated-particle
REACTOR FUELS—cycle for Fort St. Vrain Power Reactor, Unit 1, thorium carbide (ThC_2)-uranium carbide (UC_2), analysis of optimum; development of optimum coated-particle, for Fort St. Vrain Power Reactor, Unit 1; binders for carbon-coated thorium carbide (ThC) particle-type, performance of multiple resin
GRAPHITE—physical properties of purified, analysis of; radiation effects on mechanical properties of, analysis at 375 to 1250°C of neutron
PRESSURE VESSELS—strain analysis for Fort St. Vrain Power Reactor, Unit 1, prestressed concrete, description of

CONCRETES — mechanical properties of, effects of time and temperature on
URANIUM CARBIDES, THORIUM CARBIDES — ThC_2–UC_2, fuel cycle for Fort St. Vrain Power Reactor, Unit 1, analysis of optimum
REACTOR CONTROL ELEMENTS — reactivity worth of Fort St. Vrain Power Reactor, Unit 1, analysis of
REACTOR FUEL ELEMENTS — radiation effects on BISO-coated thorium carbide (ThC_2)–uranium carbide (UC_2), analysis of fast neutron
THORIUM CARBIDES, URANIUM CARBIDES — ThC_2–UC_2, radiation effects on BISO-coated, analysis of fast neutron
NEUTRONS, FAST — effects on BISO-coated thorium carbide (ThC_2)–uranium carbide (UC_2) fuel particles, analysis of
NEUTRONS — effects on mechanical properties of graphite at 375 to 1250°C, analysis of
BEARINGS — hydrodynamics of Fort St. Vrain Power Reactor, UNIT 1 blower, hybrid thrust, analysis of
RESINS — use as binders in reactor fuels
BURNABLE POISONS — reactivity effects on Fort St. Vrain Power Reactor Unit 1, calculation of
REACTIVITY — burnable poison effects on Fort St. Vrain Power Reactor Unit 1, calculation of (D.C.C.)

4170 (GA–8270) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(E) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending September 30, 1967. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 30, 1967. Contract AT(04-3)-633. 217p. Dep. CFSTI.

FORT ST. VRAIN POWER REACTOR, UNIT 1 — pressure vessel for, strain analysis for prestressed concrete; fuel cycle for, analysis of optimum; control elements for, reactivity worth of; fuel development for, analysis of optimum coated-particle; blower for, flow performance of prototype helium
REACTOR FUELS — cycle for Fort St. Vrain Power Reactor, Unit 1, thorium carbide (ThC_2)–uranium carbide (UC_2), analysis of optimum; development of optimum coated-particle, for Fort St. Vrain Power Reactor, Unit 1; binders for carbon-coated particle-type, performance of multiple resin
URANIUM CARBIDES — ThC_2–UC_2, fuel cycle for Fort St. Vrain Power Reactor, Unit 1, analysis of optimum; ThC_2–UC_2, radiation effects on BISO-coated, analysis of fast neutron
REACTOR FUEL ELEMENTS — radiation effects on BISO-coated thorium carbide (ThC_2)–uranium carbide (UC_2), analysis of fast neutron; configuration of Fort St. Vrain Power Reactor, Unit 1 proof test, for Peach Bottom Power Reactor Unit 1
PRESSURE VESSELS — strain analysis for Fort St. Vrain Power Reactor, Unit 1, prestressed concrete, description of
CONCRETES — mechanical properties of prestressed, effects of time and temperature on
HEAT TRANSFER SYSTEM — flow distribution in Fort St. Vrain Power Reactor, Unit 1, core, analysis of
THORIUM CARBIDES — ThC_2–UC_2, fuel cycle for Fort St. Vrain Power Reactor, Unit 1, analysis of optimum
REACTIVITY — calculation of Fort St. Vrain Power Reactor, Unit 1, effects of accidents on variation
REACTOR CONTROL ELEMENTS — reactivity worth of Fort St. Vrain Power Reactor, Unit 1, analysis of
RESINS — use as binders in reactor fuels
THORIUM CARBIDES — ThC_2–UC_2, radiation effects on BISO-coated, analysis of fast neutron
NEUTRONS, FAST — effects on BISO-coated thorium carbide (ThC_2)–uranium carbide (UC_2) fuel particles, analysis of
IODINE — sorption by Incoloy 800, graphite, chromium–molybdenum and mild steel, effects of time and temperature on
CHROMIUM ALLOYS AND SYSTEMS — Cr–Mo, sorption of iodine by, effects of time and temperature on
MOLYBDENUM ALLOYS AND SYSTEMS — Cr–Mo, sorption of iodine by, effects of time and temperature on
STEEL — sorption of iodine by mild, effects of time and temperature on
INCOLOY 800, GRAPHITE — sorption of iodine by, effects of time and temperature on
BLOWERS — flow performance for Fort St. Vrain Power Reactor, Unit 1, prototype helium, analysis of (D.C.C.)

4171 (NP–17597, pp 41-73) STUDIES ON THE GENERATION OF ENERGY. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

REACTOR FUELS — radiation effects on, 1967 summary of French research on; development of, 1967 summary of French
REACTOR SAFETY — research on, 1967 summary of French
REACTORS, GAS-COOLED — development of natural uranium-fueled graphite-moderated, 1967 summary of French
REACTORS, GRAPHITE MODERATED — development of natural uranium-fueled gas-cooled, 1967 summary of French
REACTORS, FRANCE — operation of power, 1967 summary of
REACTORS, POWER — operation of French, 1967 summary of
REACTOR COOLANTS — research on, 1967 summary of French
REACTORS — moderators for, 1967 summary of French research on
REACTORS, FAST — research on, 1967 summary of French
CADARACHE REACTORS (RAPSODIE); PHENIX FAST REACTOR — development of, 1967 summary of
URANIUM ALLOYS, URANIUM OXIDES UO_2, URANIUM CARBIDES, PLUTONIUM CARBIDES, PLUTONIUM OXIDES PuO_2 — use for reactor fuels, 1967 summary of French research on
GRAPHITE — use in reactor construction, 1967 summary of French research on
MAGNESIUM — use in reactor construction, 1967 summary of French research on
ALUMINUM, STEELS, CONCRETES — use in reactor construction, 1967 summary of French research on
REACTORS, RESEARCH; REACTORS, POWER; NAVAL REACTORS, CRITICAL ASSEMBLIES — table of French
FRANCE — research activities on nuclear power, 1967 summary of (H.D.R.)

4172 (ORNL–4292) POTENTIAL AGRICULTURAL PRODUCTION FROM NUCLEAR-POWERED AGRO-INDUSTRIAL COMPLEXES DESIGNED FOR THE UPPER INDO-GANGETIC PLAIN. Stout, Perry R. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 19p. Dep. CFSTI.

A proposed nuclear-powered agro-industrial complex for the upper Indo-Gangetic Plain is described. Electrical power availability for the region is tabulated; needs are compared. Uses of electricity produced from a 1000 MWe reactor are outlined; crop and chemical yields are discussed. The economics of the project is tabulated for capital costs, operating expenses, income, repayment schedules, and cost of growing wheat. 19 references. (M.L.S.)

4173 (ORNL-tr-1783) EUROPEAN EXPERIMENTAL PROGRAMS OF FAST REACTORS AND FINAL REALIZATIONS. Hurst, R. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Energ. Nucl. (Paris), 9: 271-4(June–July 1967). 13p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 1796.

4174 (RISO–M–809) INSTRUCTION SYSTEMS AND ADMINISTRATIVE PROCEDURES IN NUCLEAR REACTOR PLANTS. Timmermann, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct. 3, 1968. 7p. Dep.

Organization and instruction systems at power reactors are considered in relation to a total man-machine system. Emphasis is placed on the instruction of reactor operators in abnormal situations. (auth)

4175 ECONOMIC POTENTIAL OF DIFFERENT ADVANCED REACTOR CONCEPTS IN A FUTURE POWER GENERATING SYSTEM. Boettcher, A.; Kraemer, H.; Wagemann, K. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 439(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4176 FIRST NUCLEAR PLANT OF THE NETHERLANDS. Energ. Nucl. (Paris), 10: 293-6(Sept. 1968). (In French).

A description of the Dodewaard Power Reactor is given. Design and operating parameters are listed for the core, fuel and control rods, and containment; shielding and cooling systems are discussed briefly. Plans for a larger nuclear plant are mentioned. (M.L.S.)

4177 THE ITALIAN FAST REACTOR PROGRAM. Fogagnolo, Giorgio; Pierantoni, Ferrante. Com. Naz. Energ. Nucl., Notiz., 14: No. 8-9, 58-82(Aug.-Sept. 1968). (In Italian).

A description of the Fast Reactor Programs in Italy is presented. The program is divided in the following main areas: fuel element project for liquid Na-cooled fast power reactors; Na loop component project; PEC Reactor design; and project Filiera. (D.C.C.)

4178 COUPLED REACTORS. Lewis, W. B.; Clayton, H. H.; Hurst, D. G. (to Atomic Energy of Canada Ltd.). Canadian Patent 791,831. Aug. 6, 1968.

A nuclear power reactor is described which consists of two or more cores contained in the same calandria. A reflector surrounds all the cores which are so placed that the neutron leakage

from any one may be used to burn Xe in an adjacent, poisoned-out core. Each core is provided with booster rods capable of conferring sufficient reactivity to compensate for the loss of reactivity due to the inability of an adjacent core to provide leakage neutrons when poisoned out. An unobstructed path for leakage neutrons is left between the individual cores. (F.S.A.)

4179 NUCLEAR ENERGY IN BRAZIL. Soto, Juan Bautista (Instituto de Engenharia Nuclear, Rio de Janeiro). Energ. Nucl. (Madrid), 12: 235-46(May-June 1968). (In Spanish).

The organization of the National Commission for Nuclear Energy (CNEN) in Brazil is discussed; its functions are described. The activities of the associated departments and institutions are summarized. (M.L.S.)

4180 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Webb, John; Esson, George (to United Kingdom Atomic Energy Authority). British Patent 1,132,961. Nov. 6, 1968. Filed Nov. 13, 1964.

REACTORS, FAST—core support structure for, description of multiple valve-regulated coolant distributor pipes in (D.C.C.)

Kinetics and Dynamics

4181 (EURFNR-495) THE STABILITY OF CONTROL TRACKS WITH RIGID FEEDBACK (UNCOMPENSATED) USING THE EXAMPLE OF THE STEAM-COOLED REACTOR. Krebs, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Translated from report KFK-656. 25p. (EUR-3691). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

Stability limits of a steam cooled reactor are determined. Four coolant loop models are investigated; models considered are: with dead time, dead time and first order time lag, with and without dead time and n equal time lag constants, and with and without dead time and n different time lag constants. An example is used to illustrate the calculations. (M.L.S.)

4182 (KFK-539/1) STRUCTURE, EXPANSION, AND DISTORTION EFFECT IN THE FAST REACTOR. PART I. THEORETICAL CONSIDERATIONS. Hoang, Y. S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan. 1967. 51p. (In German). (EUR-3951). Dep.

A calculational model for determination of temperature fields in reactors is given. The method for calculating the deflection curves for a subassembly is detailed. The calculation is given of the radial deflection of the subassembly as a consequence of the loading due to the temperature field. Effects of deflection on the reactivity are determined. 12 references. (M.L.S.)

4183 INTEGRATION OF ON-LINE DATA HANDLING WITH OFF-SITE ANALYSIS FOR LARGE NUCLEAR POWER PLANTS. Caldwell, J. H. (Control Data Corp., Rockville, Md.); Kendrick, E. D. Trans. Amer. Nucl. Soc., 11: 631(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4184 NEW DEVELOPMENTS IN MOLTEN-SALT REACTOR PHYSICS. Perry, A. M.; Smith, O. L.; Kerr, H. T. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 619-20(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4185 STATISTICAL TEMPERATURE DISTRIBUTION CALCULATION IN PEBBLE BED REACTORS. Massimo, L. (EURATOM, Germany); Schmid, U. A. Trans. Amer. Nucl. Soc., 11: 657(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4186 COMPARISON OF PHYSICS MEASUREMENTS AND WEIGHTED RESIDUAL SYNTHESIS CALCULATIONS FOR THE SHIPPINGPORT PWR CORE-2 SEED-1 THROUGH DESIGN LIFE. Smith, Francis E. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 591-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4187 FAST SPECTRUM DOPPLER MEASUREMENTS ON ^{238}U AND REFRACTORY METALS TO 2000°K. Daughtry, J. W.; Groh, E. F.; Till, C. E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 562-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4188 TRANSPORT SOLUTIONS FOR TWO-DIMENSIONAL MULTIGROUP THERMAL-NEUTRON DISTRIBUTIONS IN NON-UNIFORM LATTICES. Leonard, A. (Stanford Univ., Calif.); McDaniel, C. T. Trans. Amer. Nucl. Soc., 11: 556-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4189 INTERIM CRITICAL TESTS WITH THE UO_2-2 WT PERCENT PuO_2 BATCH CORE IN THE PRTR. Kutcher, J. W.; Smith, R. I. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 588(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4190 ANALYSIS OF SPATIAL FLUX CONTROL IN HEAVY-WATER REACTORS. Trojan, O. A. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). Trans. Amer. Nucl. Soc., 11: 571-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4191 NONLINEAR XENON EFFECTS IN BOILING WATER REACTORS. Crowther, R. L. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 570-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4192 A FAST METHOD FOR THE DETERMINATION OF NEUTRON-PHYSICAL PROPERTIES FOR CORE ELEMENTS IN PEBBLE-BED REACTORS. Rausch, W.; Bachus, K. P.; v. d. Decken, C. (Brown Boveri/Krupp, Julich, Ger.). Trans. Amer. Nucl. Soc., 11: 567(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4193 STATUS OF THE NUCLEAR DESIGN OF THE HTGR. Dahlberg, Richard C. (Gulf General Atomic Inc., San Diego). Trans. Amer. Nucl. Soc., 11: 560-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4194 METHOD FOR UTILIZATION OF IN-CORE FLUX MONITOR DATA WITH APPLICATION TO LACBWR MONITORS. Fisher, J. R. (Nuclear Associates International Corp., Rockville, Md.). Trans. Amer. Nucl. Soc., 11: 631-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Control Systems

4195 (EUR-4058) ON-LOAD CALIBRATION OF THE LATINA REACTOR CONTROL RODS. Bellia, G.; Giannini, R.; Lesnoni la Parola, G.; Marzullo, T.; Paoletti Gualandi, M. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). June 18, 1968. 35p. (In Italian). Dep.

To determine the reactivity versus burn-up curve in Latina reactor is necessary to perform reactivity balances and measurements which entail knowledge of the control rod calibration curves. As the burn-up progresses, the rod calibration curves gradually deviate from the initial curves, so that the calibrations have to be periodically repeated. Since, for practical and economic reasons, the method employed during the final adjustment of the plant could not be used for on-load calibration, a method was selected for measuring a Xe transient and at the same time determining the calibration curve of a group of control rods. Measurements were carried out at 1,100 and 1,425 MWd/reactor tonnes. (auth)

4196 (RISO-M-793) DETECTOR OPTIMIZATION REGARDING GAMMA-RAYS PROBLEM IN NEUTRON NOISE MEASUREMENT. Teodosic, Vlada (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug. 1968. 13p. (R-29-68). Dep.

The very high gamma fields, existing in power reactors, present a serious problem in neutron noise measurements. This problem is discussed with a particular attention paid to the shut-down reactivity measurements in power reactors performed by the frequency analysis of the neutron, as well as of the prompt-gamma noise. It is shown that a careful selection and design of the detectors used leads to the considerable improvement of the accuracy. The recently developed method of the prompt-gamma noise analysis is presented and discussed. (auth)

4197 THE DYNAMIC BEHAVIOR OF NUCLEAR POWER STATIONS WITH AEG BOILING-WATER REACTORS. Reinhardt, Alfred. At. Strom, 14: 124-8(Sept. 1968). (In German).

Control methods have been developed which have allowed the boiling-water reactor to become the most efficient type for power stations. It can take over the function of a peak-load power station

and control the voltage rise and drop of an average network by itself. The starting process and behaviour under fault conditions are described. The instability problems are reduced to their real practical significance. (auth)

4198 CONTROLLING NUCLEAR REACTORS. Raven, Anthony David (to English Electric Co. Ltd.). British Patent 1,132,472. Nov. 6, 1968. Filed Aug. 13, 1965.

REACTORS, LIQUID METAL-COOLED — control elements in, description of U-shaped closed-end tube with pressurized liquid metal for regulating

REACTOR CONTROL ELEMENTS — drives for liquid metal-cooled reactor, description of U-shaped closed-end tube with pressurized liquid metal (D.C.C.)

Shielding

4199 DISCRETE ORDINATES STUDY OF NEUTRON ATTENUATION IN SODIUM. Marr, D. R. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 700 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4200 PROBLEMS IN THE DESIGN AND CONSTRUCTION OF FAST REACTOR SHIELDS. Hungerford, H. E. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc., 11: 708 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Cooling Systems

Refer also to abstract 3044.

4201 (CONF-670654-1) MEASUREMENTS AND PREDICTIONS OF BURNOUT CONDITIONS IN ROD BUNDLES. Becker, Kurt M. (Aktiebolaget Atomenergi, Studsvik (Sweden)). May 1967. 58p. (S-366). Dep.

From Symposium on Two-Phase Flow, Bournemouth, England.

Burnout measurements for flow of boiling water in vertical 6-rod and 7-rod bundles and one 36-rod bundle are presented. The 6- and 7-rod bundle measurements showed that for rod distances larger than 4 mm, the burnout heat flux was independent of the rod clearance. The 36-rod bundle measurements were low by 18% compared with the correlation. This discrepancy was explained by the presence of an unheated center rod, which carried the spacer arrangements, and by the fact that the inner sub-channel of the cluster carried a heavier thermal load than the remaining sub-channels. A comparison between the measured heat fluxes for the 36-rod bundle and one of the 6-rod bundles, which in geometry was identical to the central portion of the 36-rod bundle, yielded almost identical results. Finally, the 3-rod bundle data by Kunsemiller, the 9-rod bundle data by Hench and Boehm, the 19-rod bundle data by Matzner and Casterline, and the 36-rod bundle data by Edwards and Obertelli were analysed, and good agreement was obtained between the data and the correlation. (auth)

4202 (EUR-4052) DYNAMIC MODEL FOR THE COOLING CHANNELS OF A BOILING NUCLEAR REACTOR WITH FORCED CIRCULATION AND HIGH-PRESSURE LEVEL. Forti, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 21, 1968. 26p. Dep.

A dynamic model for boiling channels of nuclear reactors is proposed, which is suitable for numerical calculations in the time domain. The model is one-dimensional, and includes treatment of subcooled boiling and liquid superheating. It includes a new form of boiling heat transfer correlations and a correction of Bankoff's slip correlation for diabatic conditions. In the present formulation the model is limited to constant pressure level of the whole system, but an extension to slowly variable pressure is easy in principle. (auth)

4203 (EURFNR-564) PROBLEMS OF SODIUM BOILING IN FAST REACTORS. Smidt, D.; Fette, P.; Peppler, W.; Schlechtendahl, E. G.; Schultheiss, G. F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). June 1968. 35p. (EUR-3960; KFK-790). Dep.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

Ejection, superheat, and recondensation safety aspects of Na boiling in fast reactors are discussed. Bubble dynamics, superheat parameters, and recondensation modes are described. 32 references are included. (D.C.C.)

4204 (FEI-111) WATER-COOLED NUCLEAR REACTORS AND HEAT TRANSFER CRISIS AT BOILING. Zenkevich, B. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1967. 75p. (In Russian). Dep.

Presented is an account of the state of the art on the heat transfer crisis for the forced flow of boiling water, mainly in vertical tubes. Experimental data on the crisis are also discussed for geometrical channels of other configurations. Papers in journals, handbooks and preprints of research organizations abroad have been used. The latest experimental data on the process of two-phase flow on the basis of which the modern physical concepts of the heat transfer crisis were established are stated and analyzed. The effects of the mode and geometrical parameters on the heat transfer crisis, as well as the methods for obtaining calculated recommended ratings, are discussed. In connection with the latter, the question of parameters for simulating the crisis is discussed. Also discussed are: the results of tests on the crisis in nuclear reactors, the questions of the intensification of heat transfer to steam-water mixtures, and the indication of the heat transfer crisis in reactors by acoustical methods. (tr-auth)

4205 (NSJ-tr-131) EFFECT OF ORIFICE PRESSURE DROP ON BURN-OUT HEAT FLUX IN PARALLEL CHANNELS. Hori, Masao; Ouchi, Yoshihiro. Translated from Nippon Genshiryoku Gakkaishi, 8: 536-9(1966). 10p. Dep.

As exemplified in the case of boiling water reactors, orificing at the inlet of each channel is considered to be effective in suppressing flow instability in parallel channels. It is also expected that such orificing should affect the burn-out heat flux in parallel channels. The burn-out heat flux in parallel channels is measured by varying the single phase (orifice) pressure drop and other conditions (flow rate and inlet temperature) in atmospheric pressure. It is found that burn-out heat flux generally becomes higher as the single phase pressure drop is increased under fixed conditions of flow rate and inlet temperature. In one certain case however, the burn-out heat flux became higher with decrease of the single phase pressure drop. This was probably due to the large effect of natural circulation caused by the low flow rate of that particular case. (auth)

4206 NUCLEAR REACTORS. Booth, David Lawry (to English Electric Co., Ltd.). British Patent 1,132,465. Nov. 6, 1968. Filed May 10, 1965.

REACTORS, POWER — cooling system of, description of valve-regulated multiple parallel flow circuits for

HEAT TRANSFER SYSTEMS — configuration of valve-regulated multiple parallel flow circuits for power reactor, description of (D.C.C.)

4207 IS SODIUM REHEAT JUSTIFIED IN A SODIUM-COOLED FAST BREEDER REACTOR POWER PLANT CYCLE. Gunson, W. E. (Westinghouse Electric Corp. Msdison, Pa.); Keyfitz, I. M.; Mitchell, S. W. W. Trans. Amer. Nucl. Soc., 11: 639-40 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4208 EFFECT OF REACTOR IRRADIATION ON SANTOWAX OM AND WR. Mason, E. A.; Lee, Min-li; Brewer, Shelby T.; Bley, William N. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 498 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4209 STUDIES ON CATALYTIC RECOMBINER FOR BOILING WATER REACTORS. 2. Murata, Toshifumi; Yusa, Hideo (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 10: 561-6(Oct. 1968). (In Japanese).

The catalytic activity and mechanical strength were measured on six kinds of alumina-supported palladium catalysts, with the view to finding a suitable domestic product applicable to catalytic recombiner for boiling water reactors. The effective chemical reaction rate constants k_e of the catalysts were determined by means of the rate equation presented previously, and the effects of k_e and of the geometric outer surface area a_g on the catalytic activity were discussed. Two of the domestic catalysts examined were estimated to attain catalytic activity comparable to that of Deoxo by providing ample a_g. The mechanical strength of these domestic catalysts does not change in calcination below 600°C, and they have been found superior to Deoxo. (NSA of Japan)

4210 REMOVAL OF WATER AND CARBON DIOXIDE FROM HELIUM COOLANTS BY MOLECULAR SIEVES. Scott, Charles D. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 34: 214-23 (Dec. 1968).

The cosorption of water and CO_2 by molecular sieves is a

potential method of removing these contaminants from the He coolant of a gas cooled reactor. This system was experimentally investigated by both differential- and deep-bed tests. These tests showed that the system could be described by the rate limiting step of intracrystalline diffusion with diffusion coefficients. Sorbed CO_2 was found to be irreversibly replaced by sorbed water, and the CO_2 loading was dependent on water concentration. Differential equations were derived to describe the system of the cosorption of two interacting fluid species with Freundlich-type isotherms in a flowing fluid by a fixed bed of solids in which the sorption rate is controlled by intracrystalline diffusion. The set of differential equations was solved by a finite difference method for the case of water and carbon dioxide cosorption by molecular sieves. Generalized breakthrough curves for both water and CO_2 were determined, and their use for design purposes is demonstrated. 17 references. (auth)

4211 IMPROVEMENTS IN AND RELATING TO COOLING ARRANGEMENTS FOR NUCLEAR REACTOR PLANTS. (to Gutehoffnungshutte Sterkrade Aktiengesellschaft). British Patent 1,134,840. Nov. 27, 1968. Priority date Dec. 7, 1966, Germany.

REACTORS, GAS-COOLED — cooling system for, description of turbine adiabatic expander for gas cooling in
HEAT TRANSFER SYSTEMS — turbine adiabatic gas expander for gas-cooled reactor, description of
TURBINES — use for adiabatic gas expander in gas-cooled reactors, description of (D.C.C.)

4212 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Rigg, Shepherd (to United Kingdom Atomic Energy Authority). British Patent 1,134,520. Nov. 27, 1968. Filed Nov. 18, 1966.

REACTORS, PRESSURIZED-WATER — cooling system for, description of valve-regulated by-pass flow for multiple parallel-connected boilers in
HEAT TRANSFER SYSTEMS — pressurized-water reactor reactor, description of valve-regulated by-pass flow for multiple parallel-connected boilers in (D.C.C.)

4213 THERMAL POWER PLANT AND METHOD OF OPERATION. Gollion, Henri-Jacques; Robin, Marcel; Schwab, Bernard (to Commissariat a l'Energie Atomique). British Patent 1,134,457. Nov. 27, 1968. Priority date Apr. 29, 1966, France.

REACTORS, LIQUID METAL-COOLED — cooling system for power, description of valve-regulated by-pass flow in multi-region dual-turbine
REACTORS, POWER — cooling system for liquid metal-cooled, description of valve-regulated by-pass flow in multi-region dual-turbine
HEAT TRANSFER SYSTEMS — valve-regulated by-pass flow in multi-region dual-turbine, description of liquid metal-cooled power reactor (D.C.C.)

4214 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR PLANTS. Tonarelli, Lorenzo (to Sulzer Brothers Ltd.). British Patent 1,132,920. Nov.6, 1968. Priority date Dec. 15, 1966, Switzerland.

REACTORS, GAS-COOLED — cooling system for liquid-moderated, description of balance tank-regulated pressure equalizer for
HEAT TRANSFER SYSTEMS — pressure equalizer for liquid-moderated gas-cooled reactors, description of balance tank-regulated (D.C.C.)

Fuels

Refer also to abstracts 2369, 2510, 2703, and 3137.

4215 (AEC-tr-6946) RESULTS OF THE ENQUIRY INTO THE PROSPECTS FOR THE USE OF PLUTONIUM IN ENEL WATER REACTORS. Ariemma, A.; Belelli, U.; Lesnoni, G.; Rosa, I.; Sani, L.; Zaffiro, B. (Ente Nazionale per l'Energia Elettrica, Latina (Italy)). Translated from Excerpts of EUR-3478. 49p. Dep. CFSTI.

ENEL has begun a program on the prospects for using Pu in thermal reactors. It will be based on experimental studies in one of their own water reactors, either the Garigliano 160 MW(e) BWR reactor or the 300 MW(e) Trino Vercellese PWR reactor. Results of the physical, economic and safety studies made in order to act as a guide for the ENEL in choosing the reactor on which to concentrate subsequent studies and perform tests with a view to the use of Pu in regular reloads after 1971-1972 are presented. (auth)

4216 (BMwF-FBK-68-25) DEVELOPMENT OF EMITTERS FOR THERMIONIC FUEL RODS. Batzies, P.; Demny, J.; Schmid, H. E.; Zoeller, R. (Brown, Boveri und Cie A. G., Heidelberg (West Germany)). June 1968. 71p. (In German). Dep.

To improve emitters for thermionic fuel rods of a thermal reactor, a fuel-emitter-system UO_2-Mo was studied in and out of pile and found to be thermodynamically and chemically stable. Mo-coated particles showed no increase in fission product-retention. To increase the efficiency by high work function surfaces the needed production-, preparation- and examination-technique was developed. W-(100)-vaporplating layers showed no change in work function by diffusion over long periods of time at elevated temperatures. The workfunctions of single- and polycrystals were measured and gave literature compatible results, which will be used for comparison purposes in following etching experiments. 27 references. (auth)

4217 (EURFNR-532) INFLUENCE OF INTERNAL GEOMETRY ON RADIAL TEMPERATURE DISTRIBUTION OF FAST BREEDER FUEL ELEMENTS. Kaempf, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-751. 37p. (EUR-3710). Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A fuel element model featuring hollow cylindrical fuel and clad is used to analyze the effects of internal geometry on radial temperature distribution. The fuel and clad are separated by a gap of constant width. Formulas are developed for characterizing the effects of central channel, fuel porosity, and fuel-clad gap changes during reactor operation. Other effects which change temperature distribution during reactor operation are characterized qualitatively. The internal geometry effects on temperature distribution are numerically evaluated and plotted. (H.D.R.)

4218 (GA-8467) SUMMARY REPORT ON THE USE OF TRISO-COATED PARTICLES IN THE PSC REACTOR PLANT. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 31, 1968. Contract AT(04-3)-633. 116p. Dep. CFSTI.

Topics discussed include: preparation and properties of vapor-deposited SiC; design of BISO-SiC (TRISO) coated particles; integrity of BISO-SiC (TRISO) coated particles; fission product retention of SiC; vapor pressure of Sr sorbed on graphite; effects of SiC on fission product inventories in Fort St. Vrain Power Reactor Unit 1; and effects of SiC on reactor design parameters. (D.C.C.)

4219 (ORNL-TM-2173) FUEL-CYCLE COST COMPARISONS FOR LOW-ENRICHED URANIUM, HIGH-TEMPERATURE GAS-COOLED REACTORS. Steiner, Don (Oak Ridge National Lab., Tenn.). Sept. 9, 1968. Contract W-7405-eng-26. 57p. Dep. CFSTI.

Multigroup point-depletion physics calculations are performed for equilibrium fuel cycles without recycle; thermal-hydraulic performance and fuel cycle costs are determined for three fuel element designs. Power densities and pressure drops are calculated. Reactor design and operations parameters are given. Economics are detailed; data for the three fuel element designs are tabulated. 21 references. (M.L.S.)

4220 (UNC-5224) FAST REACTOR MIXED-CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM. Fourth Quarterly Progress Report, April-June 1968. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). Sept. 26, 1968. Contract AT(30-1)-3415. 52p. Dep. CFSTI.

REACTORS, BREEDER — fuel development for LMFBR-type, description of plutonium carbide (PuC)-uranium carbide (UC)
EXPERIMENTAL BREEDER REACTOR-II — fuel element performance in, analysis of high power plutonium carbide (PuC)-uranium carbide (UC) rod-type
REACTOR FUEL ELEMENTS — fabrication of EBR-2 high- and low-power plutonium carbide (PuC)-uranium carbide (UC) rod-type, description of
URANIUM CARBIDES — fabrication of pellet-shaped, description of
PLUTONIUM CARBIDES — PuC-UC, fabrication of, description of
URANIUM CARBIDES — PuC-UC, fabrication of, description of
PLUTONIUM OXIDES PuO_2 — PuO_2-UO_2, fabrication of sintered pellet-shaped, description of
URANIUM OXIDES UO_2 — PuO_2-UO_2, fabrication of sintered pellet-shaped, description of (D.C.C.)

4221 (ZFK-129) CORROSION OF CANNING MATERIAL IN LIQUID SODIUM. Rettig, Dieter (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). Oct. 1967. 54p. (In German). Dep.

The mechanisms of corrosion of fuel element clad materials in flowing Na are defined; both thermodynamics and kinetics are considered. Corrosion research efforts are detailed; the results are evaluated. Effects of Na purity are discussed; cleaning methods for flowing Na are considered. 171 references. (M.L.S.)

4222 FUEL ELEMENTS FOR BOILING-WATER REACTORS. Hoechel, Jochen. At. Strom., 14: 117-20(Sept. 1968). (In German).

The development and fabrication of fuel elements for boiling-water reactors are described. At first the construction of the elements is described and then the possibilities of further development of the fuel elements to meet the future more stringent requirements. The fabrication of fuel elements on a large scale in the Kernreaktorteile GmbH (KRT) is described. The production process is given in detail. In a review of further standardization possible improvements in the efficiency of fuels are indicated. (auth)

4223 ASPECTS ON THE DEVELOPMENT AND FABRICATION OF FUEL ELEMENTS FOR POWER REACTORS. Hildenbrand, Guenter. At. Strom, 14: 121-3(Sept. 1968). (In German).

An interpretation of the development program for fuel elements of various reactor types is presented. Subsequently a summary is given on the production of fuel elements. (auth)

4224 DESTRUCTIVE EXAMINATION OF AN AXIALLY RESTRAINED PELLETED MIXED-OXIDE SPECIMEN THAT FAILED DURING TRANSIENT OVERPOWER CONDITIONS. Thomas, Garry R.; Field, John H. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc., 11: 697-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4225 TREAT EXPERIMENTAL STUDY OF SURVIVAL OF EBR-II FUEL PIN IN A LOSS-OF-BOND INCIDENT. Willis, F. L. (Argonne National Lab., Ill.); Dickerman, C. E.; Henault, P.; Purviance, R.; Boland, J. F.; Noland, R. Trans. Amer. Nucl. Soc., 11: 698(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4226 ANALYSIS OF TRANSIENT BEHAVIOR OF UNBONDED EBR-II FUEL PIN INCIDENT. Dickerman, C. E. (Argonne National Lab., Ill.); Smith, R. R.; Willis, F. L.; Cohen, A. B.; Regis, J. Trans. Amer. Nucl. Soc., 11: 698-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4227 ENGINEERING DEVELOPMENT OF MSBR FUEL RECYCLE. Whatley, M. E.; McNeese, L. E.; Ferris, L. M.; Carter, W. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 620-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4228 ^{232}Th DOPPLER COEFFICIENT MEASUREMENTS IN HTGR-TYPE FUEL ELEMENTS. Bardes, R. G.; Gillette, E. M.; Nirschl, R. J. (Gulf General Atomic Inc., San Diego). Trans. Amer. Nucl. Soc., 11: 561-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4229 AN ANALYSIS OF THE EFFECTS OF SMEARED DENSITY ON THE THERMAL AND BURNUP BEHAVIOR OF MIXED-OXIDE FAST REACTOR FUEL PINS. Sayles, C. W. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 509-10(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4230 NITRIDE FUEL-CLADDING COMPATIBILITY. Hebeisen, J. C.; Price, D. E.; Moak, D. P. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 510-11 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4231 FUNDAMENTAL STUDY OF THE COMPATIBILITY OF STAINLESS STEEL AND MIXED CARBIDE FUEL. Holden, Robert B.; Fuhrman, Nathan (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 511(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4232 COMPATIBILITY OF VANADIUM ALLOYS WITH (U,Pu) CARBIDES. Latimer, Trent W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 511-12(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4233 THEORETICAL AND COMPUTER ANALYSIS ON THE BEHAVIOR OF FAST REACTOR FUEL PINS AND RELATED PARTS OF THE CORE UNDER OPERATIONAL CONDITIONS. Karsten, G.; Kaempf, H.; Gerken, A. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 513(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4234 SODIUM CORROSION OF POTENTIAL LMFBR MATERIALS. Schrock, S. L.; Baysden, J. N.; Miller, R. L. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 504-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4235 URANIUM/PLUTONIUM OXIDE FUEL IRRADIATION EXPERIMENTS RELATED TO FAST REACTORS. Coquerelle, M.; Gabolde, J.; Lesser, R.; Samsel, G. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 516(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4236 PLUTONIUM FUELS PERFORMANCE: ANL EXPERIENCE. Neimark, L. A.; Murphy, W. F.; Brown, F. L.; Kittel, J. H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 516-18(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4237 PLUTONIUM CERAMIC FUELS FOR FAST REACTORS. Murray, P.; Boltax, A.; Biancheria, A. M.; Ray, W. E. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 518(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4238 UTILIZATION OF CARBIDE FUELS IN FAST REACTORS. Shapiro, M. M.; Strasser, A. A.; Cherry, B. H. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 518-19(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4239 HIGH BURNUP PLUTONIUM OXIDE IRRADIATIONS. Chritensen, J. A. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 522-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4240 IRRADIATION OF MIXED-NITRIDE FUEL. Bauer, A. A.; Fromm, E. O.; Saling, J. H.; Storhok, V. W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 11: 523-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4241 NONSTOICHIOMETRY EFFECTS ON THE MICROSTRUCTURE OF IRRADIATED UO_2-25 WT PERCENT PuO_2 FUELS. Christensen, J. A. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 524(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4242 SWELLING RATES OF MIXED-OXIDE FUEL AND CLADDING IN FAST FLUX. Baily, W. E.; Nelson, R. C.; Rubin, B. F.; Spalaris, C. N. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc., 11: 515-16(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4243 VENTING DEVICE FOR SODIUM-COOLED FAST CERAMIC REACTOR FUEL ELEMENTS. Gerosa, A.; Martini, M. (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 508-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4244 THE USE OF PLUTONIUM IN THE HTGR. George, C. (Gulf General Atomic Corp., San Diego, Calif.); Jaye, S.; Astley, Wayne. Trans. Amer. Nucl. Soc., 11: 439-40(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4245 ^{236}Pu CONTAMINANT IN ^{238}Pu PRODUCED IN POWER REACTORS. Topp, S. V. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc., 11: 457-8(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4246 COMPARATIVE ANALYSIS OF FAST BREEDER FUEL FABRICATION METHODS. Ferrari, S.; Giaquinto, L.; Moretti, S.; Testa, G. (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 450-2(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4247 EXPERIMENTAL TEST OF THE FREVAP-8 CODE FOR CALCULATING METAL FISSION-PRODUCT RELEASE FROM HTGR FUEL ELEMENTS. de Nordwall, H. J. (Oak Ridge National Lab., Tenn.); Pierce, V. H.; Zumwalt, L. R. Trans. Amer. Nucl. Soc., 11: 490-2(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4248 FAST-REACTOR-INDUCED SWELLING BY VOID FORMATION IN TYPE-304L STAINLESS STEEL. Holmes, J. J.; Brager, H. R. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 479(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4249 IN-REACTOR PERFORMANCE OF DEFECTED ZIRCALOY-CLAD U_3Si. Chalder, G. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 495-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4250 FAST REACTOR IRRADIATIONS. Russcher, G. E.; Dahl, R. E. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 499(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4251 IN-PILE FUEL STUDIES FOR DESIGN PURPOSES. Testa, G.; Doria, F.; Grillo, P.; Nobili, A.; Rotoloni, P. L. (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 492-3(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4252 MODEL FOR BURNUP OPTIMIZATION STUDY OF POWER REACTORS. Suzuki, Atusyuki; Kiyose, Ryohei (Tokyo Univ.). Trans. Amer. Nucl. Soc., 11: 441-2(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4253 MODIFIED DYNAMIC PROGRAMMING ALOGRITHM FOR THE OPTIMIZATION OF BWR FUEL MANAGEMENT. Stover, Roger L. (Westinghouse Electric Corp., Pittsburgh); Sesonske, Alexander. Trans. Amer. Nucl. Soc., 11: 442(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4254 PARAMETRIC STUDIES OF LMFBR FUEL FABRICATION COSTS. Goldman, A. E.; Lotts, A. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 443(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4255 EFFECT OF ECONOMIC PARAMETER VARIATIONS ON CYLINDRICAL LMFBR CORE OPTIMIZATION. Prabulos, J.; Noyes, R. (Combustion Engineering, Inc., Windsor, Conn.). Trans. Amer. Nucl. Soc., 11: 443-4(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4256 PERMISSIBLE DESIGN REGIMES FOR A (Pu,U)C LMFBR. Dyos, M. W. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 444(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4257 UTILIZATION OF MIXED CARBIDE AS A LMFBR RELOAD FUEL. Cherry, B. H. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 444-5(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4258 ILLUSTRATIVE POWER REACTOR PROGRAMMES: APPENDICES. Prospects for Nuclear Energy in Western Europe. Paris, European Nuclear Energy Agency, 1968. 49p.

Appendices include: input data; integrated U and Th requirements for 1990, 2000, and 2010; Pu stocks in 1990, 2000, and 2010; reprocessing and fabrication capacities; summary of Dutch computer program; summary of Swedish computer program; and summary of Italian computer program. (D.C.C.)

4259 A STUDY OF THE RELEASE OF RADIOACTIVE METALLIC ISOTOPES FROM HIGH-TEMPERATURE GAS-COOLED REACTORS. Appel, J.; Roos, B. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng., 34: 201-13 (Dec. 1968).

An exact formulation is presented for the release of metallic fission products. Such radioactive atoms are created through fission processes inside the kernel of fuel particles. They can diffuse through the coating of a fuel particle and the surrounding charcoal matrix into the structural graphite of the reactor core. Some atoms traverse this graphite along internal surfaces and finally enter the coolant gas. To find the number of radioactive atoms released into the coolant gas, the diffusion equation in one space dimension is solved numerically taking into account as driving forces both the gradient of the chemical potential and that of the temperature field. The chemical potential is determined respectively by the Langmuir and Freundlich adsorption isotherms for small and large concentrations of metal atoms adsorbed at the highly active internal surfaces of charcoal and graphite. As an example, a parameter study of the release is presented for the most dangerous radioactive metallic isotope, ^{90}Sr. The calculation of the release rate from a single fuel particle shows that the coating does not act as an effective diffusion barrier in this case. It is found that the structural graphite governs the release by virtue of its good adsorptive properties and its low diffusion constant. The results for the concentration profile, the mass current (or flux), and the release of ^{90}Sr are highly sensitive to experimental information on diffusion and adsorption coefficients, in part because of the temperature-activated nature of adsorption and diffusion processes. Since the experimental variables are known with limited accuracy only, a parameter study of the ^{90}Sr release is carried out, that is centered around the best available empirical values for diffusion and adsorption coefficients. 14 references. (auth)

4260 FUEL ASSEMBLY FOR NUCLEAR REACTORS. (to Westinghouse Electric Corp.). British Patent 1,133,177. Nov. 6, 1968. Priority date May 25, 1966, United States.

REACTOR FUEL ELEMENTS — assemblies of multiple elongated, description of coolant deflecting vanes for grid-supported parallel-spaced (D.C.C.)

Auxiliary and Emergency Systems

Refer also to abstract 3012.

4261 CALIBRATION OF ELECTROMAGNETIC FLOWMETERS IN THE ENRICO FERMI ATOMIC POWER PLANT. Meshii, T. (Central Research Inst. of the Electric Power Industry, Tokyo); Ford, J. A. Trans. Amer. Nucl. Soc., 11: 632-3(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4262 REMOTE HANDLING SYSTEM FOR CORE ELEMENTS OF A PEBBLE-BED REACTOR. Hennings, U. (Brown Boveri/Krupp, Julich, Ger.). Trans. Amer. Nucl. Soc., 11: 646-7(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4263 FUEL-MOTION RESTRICTOR SCREENING CAPSULE IRRADIATIONS. Pember, L. A.; Crawford, R. M. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 509(Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Operation and Economics

4264 (GA-8816) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending July 31, 1968. (Gulf General Atomic, Inc., San Diego, Calif.). Aug. 30, 1968. Contract AT(04-3)-314. 94p. Dep. CFSTI.

PEACH BOTTOM POWER REACTOR, UNIT 1 — operations during May to July 1968
REACTOR CONTROL ELEMENTS — calibration of Peach Bottom Power Reactor Unit 1, description of

REACTOR CONTROL SYSTEMS—performance of Peach Bottom Power Reactor Unit 1 automatic, analysis of startup and power
XENON-135—buildup in Peach Bottom Power Reactor Unit 1 of, effects of power level on
HELIUM—flow rates for Peach Bottom Power Reactor Unit 1 coolant, calibration of; purification system for Peach Bottom Power Reactor coolant, performance of
REACTIVITY—measurements of Peach Bottom Power Reactor Unit 1, effects of full power days on
REACTOR FUEL ELEMENTS—burnup of Peach Bottom Power Reactor Unit 1, analysis of; failures in Peach Bottom Power Reactor Unit 1; analysis of (D.C.C.)

4265 MSRE SURVEILLANCE PROGRAM. Cook, W. H. (Oak Ridge National Lab., Tenn.); Taboada, A. Trans. Amer. Nucl. Soc., 11: 621-2 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4266 GRAPHITE AND XENON BEHAVIOR AND THEIR INFLUENCE ON MOLTEN-SALT BREEDER REACTOR DESIGN. Scott, Dunlap; Eatherly, W. P. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 622 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4267 PRE-LAYUP INSPECTION OF EBWR REACTOR VESSEL. Sutton, C. R.; Balai, N. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 648-9 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4268 RECENT EXPERIENCE WITH THE MOLTEN-SALT REACTOR EXPERIMENT. Haubenreich, Paul N.; Engel, J. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 619 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Safety and Siting

Refer also to abstract 4447.

4269 (ANL-7361) CHEMLOC-II: A COMPUTER PROGRAM DESCRIBING THE CORE HEATING AND CLADDING-STEAM REACTION FOR A WATER-COOLED POWER REACTOR FOLLOWING A LOSS OF COOLANT. Hesson, James C.; Anderson, John L.; Ivins, Richard O. (Argonne National Lab., Ill.). Apr. 1968. Contract W-31-109-eng-38. 115p. Dep. CFSTI.
A complete description, including input/output format and examples, of the CHEMLOC-II computer program is given. The program calculates the extent of core heating and metal-steam reaction following a coolant loss accident in a water cooled reactor. Computations are carried from the end of blowdown, through core heating, chemical reaction, failure, and core collapse. Equations used in the program are listed. Source language is FORTRAN 3600. 19 references. (M.L.S.)

4270 (BMI-1850) AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT. Quarterly Progress Report, July-September 1968. Morrison, David L.; Carbiener, Wayne A.; Ritzman, Robert L. (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1968. Contract W-7405-eng-92. 56p. Dep. CFSTI.
ZIRCALOY—cladding of, heat transfer characteristics during failure in; corrosion by steam of, effects of temperature transients on
REACTORS, PRESSURIZED-WATER—accidents in 1000 MW(e), calculation of coolant flow requirements for core failure
REACTOR SAFETY—core failure in 1000 MW(e) pressurized-water reactor, coolant flow requirements for
REACTOR FUEL ELEMENTS—failure of Zircaloy-clad uranium oxide (UO_2) pin-type, heat transfer characteristics during
URANIUM OXIDES UO_2—fuel element of, heat transfer characteristics during failure in
STEAM—corrosive effects on Zircaloy of, analysis of
HEAT TRANSFER SYSTEM—fluid flow model for emergency core cooling, analysis of, (T)
IODINE—fission product containment, analysis of pressurized-water reactor accident (D.C.C.)

4271 (BNWL-867) NUCLEAR REACTOR SYSTEM NOISE ANALYSIS, DRESDEN I REACTOR, COMMONWEALTH EDISON COMPANY. Hutton, P. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 19p. Dep. CFSTI.
The use of "acoustic emission", produced as metals deform and fracture, as a means of continuously monitoring the integrity of nuclear reactor pressure boundaries is described. In-plant noise measurements on several reactor systems are necessary to provide an adequate definition of the noise field. The Dresden I Nuclear Power Reactor at Morris, Illinois has a low noise field above 500 kHz. This provides a region nominally from 750 kHz to about 3 MHz (where signal attenuation with increasing frequency rises sharply for ferrous materials) which is conducive to reliable detection of acoustic emission signals. Detector response to acoustic emission has been demonstrated within and well beyond this region. Although the results can not be considered universally applicable to reactor systems, they do provide strong encouragement for continued monitor system development. They, also, define a region for beneficial effort on improved detection techniques. (auth)

4272 (IDO-17264) ENGINEERING AND TEST BRANCH. Quarterly Technical Report, January 1-March 31, 1968. Dietz, K. A. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Sept. 1968. Contract AT(10-1)-205. 97p. Dep. CFSTI.
REACTORS, PRESSURIZED-WATER—coolant loss accident in, BURST-2 computer program analysis of; coolant loss accident in simulated 1000 MW(e), RELAPSE computer program analysis of blowdown for; coolant loss accident in, BAM computer program for subcooled fluid depressurization in
REACTOR SAFETY EXPERIMENTS—coolant loss accident simulation in LOFT, BURST-2 computer program requirements for; fuel pin thermal properties for LOFT, calculation of optimum; coolant loss accident simulation in LOFT, RELAPSE computer program analysis of blowdown for; coolant loss accident simulation in LOFT, analysis of iodine-131 release and distribution for
REACTOR SIMULATORS—design characteristics of analog, analysis of, (T); use of analog computer for testing PBF acoustic filter, description of
PUMPS—operating characteristics of LOFT centrifugal primary, analysis of
REACTOR FUEL ELEMENTS—thermal properties of LOFT Zircaloy 4-clad uranium dioxide (UO_2), calculation of optimum
ZIRCALOY-4—thermal properties of cladding of, calculations of optimum
URANIUM OXIDES UO_2—thermal properties of, calculation of optimum
FISSION PRODUCTS—distribution in LOFT coolant loss accident, analysis of, (T)
IODINE-131—distribution in LOFT coolant loss accident, analysis of blowdown
REACTOR EXPERIMENTAL FACILITIES—configuration of simulated pressurized-water reactor coolant loss accidents, description of model core and vessel
FILTERS—simulation of PBF acoustic, description of analog computer
POWER BURST FACILITY—acoustic filter performance simulation for, use of analog computer for
COMPUTER PROGRAMS—BAM, for depressurization rates and core hydraulic loads in pressurized-water reactor subcooled region, FORTRAN 63 for CDC-1604 (D.C.C.)

4273 (IDO-17278) INTERIM REPORT ON SECHT SERIES I AND II TESTS AND ANALYSIS. Schlenker, L. D.; Moser, C. M.; Little, W. S. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Aug. 1968. Contract AT(10-1)-205. 35p. Dep. CFSTI.
Bottom entry flooding tests were conducted using an electrically heated thirty-seven rod bundle arranged in a modified BWR type geometry. The test array had a three-foot heated length with a maximum initial surface temperature in excess of 2140°F. The effect of flooding rate, flooding technique, initial heater surface temperature and inlet coolant temperature were investigated. The first films of the core cooling mechanism for the bottom flooding technique were made. Correlation of these films with thermocouple records indicates that the temperature excursion was arrested principally by the mechanisms of steam convection and thermal radiation to the entrained liquid. This occurred much earlier than quenching at the same elevation. Subject to considerations of simulation accuracy, these scoping tests indicate that bottom flooding is an effective means of arresting reactor core temperature transients following a loss-of-coolant accident. (auth)

4274 (ORNL-NSIC-24) EMERGENCY CORE-COOLING SYSTEMS FOR LIGHT-WATER-COOLED POWER REACTORS.

Lawson, C. G. (Oak Ridge National Lab., Tenn.). Oct. 1968. Contract W-7405-eng-26. 166p. Dep. CFSTI.

Emergency water-injection and core-cooling for four light water cooled reactors are described and reviewed: Browns Ferry, Turkey Point, Oconee, and Palisades. Design parameters for the core, Emergency Core Cooling Systems (ECCS), primary system automatic relief valves, condensate pumping system, and ECCS operation are tabulated for each reactor. Special considerations for pressurized water reactors (PWR) are discussed; coolant loss effects common to both the PWR and the boiling water reactor (BWR) are considered. Experimental data and analyses available for design calculations are summarized. Some recommendations are drawn from the above analyses. 57 references. (M.L.S.)

4275 (ORNL-NSIC-52) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-15. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 414p. Dep. CFSTI.

Bibliographic information on nuclear safety is classified according to the following categories: General Safety Criteria; Siting of Nuclear Facilities; Transportation and Handling of Radioactive Materials; Aerospace Safety; Accident Analysis; Reactor Transients, Kinetics, and Stability; Fission Product Release, Transport, and Removal; Sources of Energy Release Under Accident Conditions; Nuclear Instrumentation, Control, and Safety Systems; Electrical Power Systems; Containment of Nuclear Facilities; Plant Safety Features; Radiochemical Plant Safety; Radionuclide Release and Movement in the Environment; Environmental Surveys, Monitoring and Radiation Exposure of Man; Meteorological Considerations; Operational Safety and Experience; and Safety Analysis and Design Reports. (M.L.S.)

4276 (SNE-46) INVESTIGATION OF THE USE OF AQUEOUS SOLUTIONS AS EMERGENCY COOLANTS. Third Quarterly Report. McCullough, C. Rogers; Brown, Gilbert M.; Hancock, R. P. (Southern Nuclear Engineering, Inc., Dunedin, Fla.). Oct. 1, 1968. Contract AT(40-1)-3749. 42p. Dep. CFSTI.

Results of screening tests on emergency coolant additives are given. Selection of sodium perborate for single rod-heated enclosure tests is discussed. Single rod-heater test apparatus is described; test results using these assemblies are shown graphically. Multi-rod test equipment is described. (M.L.S.)

4277 APPLICATION OF FINITE ELEMENT TECHNIQUES FOR THE CRACK AND ULTIMATE PRESSURE ANALYSIS OF A PRESTRESSED CONCRETE REACTOR VESSEL. Cornell, Darrell C. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 642 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4278 UNDERSEA REACTOR SITING CONSIDERATIONS. Endebrock, R. N.; D'Ardenne, W. H.; Witzig, W. F. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc., 11: 613-14 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4279 A NATURAL-CONVECTION MODEL FOR PREDICTING ELEMENTAL IODINE TRANSPORT IN CONTAINMENT VESSELS. Hilliard, R. K. (Battelle Memorial Inst., Richland, Wash.); Knudsen, J. G. Trans. Amer. Nucl. Soc., 11: 668-9 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4280 VIBRATION TESTING AND EARTHQUAKE RESPONSE OF NUCLEAR REACTORS. Smith, Craig B.; Matthieson, R. B. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc., 11: 664-5 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4281 COMPARISON OF CHIC-KIN AND PARET CALCULATIONS WITH REACTIVITY ACCIDENT TEST RESULTS FOR THE OXIDE-FUELED SPERT-III REACTOR. Allen, C. L. (Atomic Energy Commission, Washington, D. C.); McCardell, R. K.; Herborn, D. I. Trans. Amer. Nucl. Soc., 11: 678 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4282 THE SIGNIFICANCE OF HEAT CAPACITIES AND TIME DELAYS ON THE THERMAL TRANSIENT REQUIREMENTS FOR LMFBR COMPONENTS. Schmidt, R.; Heck, F. M.; Wolfe, C. F. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc., 11: 695-6 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4283 MAXIMUM ACCIDENT OF ZONED FAST REACTORS. Sha, W. T. (Argonne National Lab., Ill.); Nicholson, R. B. Trans. Amer. Nucl. Soc., 11: 696-7 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4284 CONSIDERATIONS OF SODIUM CONDITIONS AND MOLTEN-FUEL/SODIUM INTERACTIONS FOR FAST REACTOR EXCURSION CALCULATIONS. Waltar, Alan E.; Harris, Richard A.; Padilla, Andrew Jr. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 694-5 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4285 SODIUM BOILING RESEARCHES RELATED TO FAST REACTOR SAFETY. Pinchera, G. C.; Tomassetti, G.; Falzetti, L.; Fornari, G. (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 691-2 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4286 VOID FRACTION PROFILE IN A VESSEL DURING COOLANT BLOWDOWN. Wilburn, N. P. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 684-5 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4287 VOID FRACTION AND RESIDUAL WATER PREDICTIONS DURING LOSS-OF-COOLANT. Redfield, J. A.; Murphy, J. H. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 685-6 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4288 RADIOACTIVITY OUTSIDE REACTOR VESSEL. Chiovato, O.; Maggioni, G. (Applicazioni e Richerche Scientiche, Milan). Com. Naz. Energ. Nucl., Notiz., 14: No. 10, 47-51 (Oct. 1968). (In Italian).

In the framework of nuclear reactor safety problems, considerable importance is assumed by the study of the "release" of fission products within and without the vessel due to accidents. The resulting radioactive contamination of the surrounding area can create serious radiation hazards to all persons located in the contaminated space. The evaluation of these hazards, due to its complexity, requires the use of numerical methods. The development of numerical methods for the study of the radiation hazards of this kind, with special regard to the problems connected with Project Cirene, is described. (auth)

4289 PRESSURE DIFFERENTIALS WITHIN A COMPARTMENTED CONTAINMENT, FOLLOWING A PRIMARY SYSTEM RUPTURE. Seipel, H. G.; Meinhardt, D. (Technische Ueberwachungs-Vereine eV, Rheinland, Ger.). Atomkernenergie, 13: 401-7 (Nov.-Dec. 1968). (In German).

A computer program, which calculates the time dependent pressure in the various compartments of a reactor containment vessel following a primary system rupture, is described. The vapor flow pattern is approximated by a quasi-steady-state model. Changes of flow cross sections between the compartments can occur due to breaking of walls, and lifting of shield plugs and removable concrete blocks. The program provides for time and pressure dependent changes of flow cross sections, taking into account inertia effects. Some numerical computer results are presented for pipe ruptures within a large power reactor containment consisting of 14 compartmental sections. The results show that dangerous missile generation can occur. However, the rise of unpermissible pressure differentials can be avoided by adequate design of the openings between the compartments. Additionally, design formulas and curves are included to enable the designer to determine the minimum flow area that is needed within a compartment to keep the maximum differential pressure below a given value. (auth)

4290 CONCERNING NUCLEAR POWER SAFETY. Piper, Henry B. (Oak Ridge National Lab., Tenn.). Nucl. News, 11: No. 12, 54-9 (Dec. 1968).

Quotes from three different publications that printed articles concerning nuclear power and reactor safety are presented. Statements are inserted to clarify or refute the misconstrued or incorrect quotes. (D.C.C.)

4291 EARTHQUAKE RESISTANT DESIGN FOR NUCLEAR POWER PLANTS. Muto, K. (Kajima Construction Co., Tokyo); Hisada, T. Trans. Amer. Nucl. Soc., 11: 664 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Power Conversion Systems

4292 (TRG-Report-1734) INTEGRATED GAS TURBINE PLANTS USING CO_2-COOLED REACTORS. Kronberger, H.; Maillet, E.; Coast, G. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). 1968. 12p. (CONF-680525-6). Dep. CFSTI. UK.

From ENEA Symposium on the Technology of Integrated Primary Circuits for Power Reactors, Paris, France.

Various thermodynamic cycles for gas turbine systems are discussed and the characteristics of each are summarised. It is shown that for a particular cycle a compact integrated system can be engineered; this is illustrated by a design concept based on a fully integrated 750 MW(e) reactor with three 250 MW(e) power turbine-generator units. An appreciation of the development aspects involved is briefly discussed with reference to design of pressure vessel, reactor core, rotating machinery, and heat transfer equipment. Comparative cost of equipment for steam and gas turbine AGR type stations suggests that gas turbine systems could give worth-while reductions in capital investment. (UK)

4293 NUCLEAR REACTOR POWER PLANTS. Rigg, Shepherd; Brocklebank, Richard Bennett (to United Kingdom Atomic Energy Authority). British Patent 1,133,311. Nov. 13, 1968. Filed Sept. 9, 1965.

REACTORS, POWER — cooling system for water-cooled direct cycle, description of integral indirect heat multistage
REACTORS, WATER-COOLED — cooling system for direct cycle power, description of integral indirect heat multistage
HEAT TRANSFER SYSTEMS — configuration of integral indirect heat multistage, for direct cycle water-cooled power reactor (D.C.C.)

4294 POWER PLANTS. Turrell, Joseph Francis (to English Electric Co., Ltd.). British Patent 1,133,084. Nov. 6, 1968. Filed Sept. 17, 1965.

REACTORS, POWER — cooling system of, description of steam turbine-drives for boiler feed pump and auxiliary power for
HEAT TRANSFER SYSTEMS — configuration of steam turbine-drives for boiler feed pump and auxiliary power for power reactor, description of (D.C.C.)

Research and Test Reactors

Refer also to abstracts 2572, 2632, and 4164.

4295 (AAEC/TM-472) A PRELIMINARY STUDY OF THE AUTOMATIC SPEED CONTROL FOR THE ABORIGINE GAS TURBINE RIG. Gilbert, C. P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1968. 54p. Dep.

A preliminary analogue study is made of the automatic speed control of a rig consisting of a non-fissile pebble bed heated by a propane-air mixture which is circulated by a gas turbine. Equations describing the system are formulated, design of a controller using frequency response methods with linearized equations is discussed, and the behavior of a non-linear model of the system is studied. Close agreement between the frequency response work and the analogue computer results is obtained. Because a simple fuel fault could cause a serious accident, the system should not be operated without adequate thermal inertia within the pressure vessel. The analogue results stress the need for an adequate bypass valve for flow control over the full range of operation of the system. (auth)

4296 (AD-671182) THERMAL NEUTRON FLUX IN THE THERMAL COLUMN OF THE NRL REACTOR. Final Report. Vogt, R. H.; Cosgrove, Christine M. (Naval Research Lab., Washington, D. C.). Apr. 18, 1968. 7p. (NRL-6704). CFSTI.

In certain nuclear reactor experiments it is necessary to know how the thermal-neutron flux and the Cd ratio vary within the exposure cavity of the thermal column. The neutron flux in the thermal column of the NRL reactor is measured with Au detectors. The thermal flux in a cavity in the graphite has a maximum value of 10^{10} neutrons/sq cm sec at 1 MW power and a Cd ratio of 470 for the Au detector. The flux was determined at points along the vertical axis of the cavity. (auth)

4297 (AE-331) A COMPARISON OF THEORETICAL AND EXPERIMENTAL VALUES OF THE ACTIVATION DOPPLER EFFECT IN SOME FAST REACTOR SPECTRA. Haeggblom, H.; Tiren, L. I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Aug. 1968. 27p. Dep.

Results of activation Doppler measurements on the ^{238}U (n,γ) and ^{235}U (n,f) reactions in the FR-O and MSCA fast critical assemblies are compared with theoretical values. The study covers neutron spectra with median fission energies from 50 to 240 keV. The calculated Doppler effect in ^{238}U in the FR-O cores is 20 to 35 percent lower than the measured values. The sensitivity of the theoretical result with regard to changes in cross sections and neutron spectrum are studied. The theoretical value for ^{235}U (FR-O core 5) is 4 times higher than the measured one. A brief description is given of the DORIX-2 method of calculating effective resonance cross sections appropriate to activation Doppler measurements. References to the cross section data used for the comparisons are also given. (auth) (Sweden)

4298 (ANL-6271(Add.2)) SAFETY ANALYSIS OF A NOMINAL 3700-LITER UO_2 CORE IN THE ZPR-6 AND -9 FACILITY. Rusch, G. K.; Karam, R. A. (Argonne National Lab., Ill.). July 1968. Contract W-31-109-eng-38. 10p. Dep. CFSTI.

The relevant safety characteristics and maximum credible accidents for 50-, 2600-, and 3700-liter UO_2 systems are compared. The calculations demonstrate that the proposed 3700-liter system can be built safely with no additional hazard, compared to the previously approved systems. 5 references. (H.D.R.)

4299 (BAW-3647-9) PHYSICS VERIFICATION PROGRAM. PART III. Quarterly Technical Report, April-June 1968. Baldwin, M. N.; Stern, M. E. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Sept. 1968. Contracts AT(30-1)-3647; 41-2007(RDE 2559). 18p. Dep. CFSTI.

The relating of the signal current from a Rh-type in-core power monitor to the neutron flux is described for temperatures approaching those of an operating power reactor. Measurements are made in borated and nonborated water. (D.C.C.)

4300 (BNWL-880) FAST FLUX TEST FACILITY. Quarterly Progress Report, April-June 1968. Astley, E. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 451p. Dep. CFSTI.

FAST FLUX TEST FACILITY — site for, building arrangement on; radioactive waste disposal system of, flow diagram for; pressure vessel for, description of arrangements 2, 7, and 9; control systems of, description of core instrumentation for; core configuration for, description of optimum; core physics parameters for, description of; power systems for, reliability analysis of; fuel assemblies for, fabrication of; experimental facilities for, description of liquid sodium sampling
RADIOACTIVE WASTE — disposal system for Fast Flux Test Facility, flow diagram of
SHIELDED CONTAINERS — configuration of Fast Flux Test Facility radioactive waste transfer, description of
CRITICAL ASSEMBLIES — configuration of Nuclear Proof Test Facility, description of arrangement 1
PRESSURE VESSELS — configuration of Fast Flux Test Facility, description of arrangements 2, 7, and 9
REACTOR CONTROL SYSTEMS — instrumentation for Fast Flux Test Facility, description of core
REACTOR SAFETY — shutdown temperature transients for Fast Flux Test Facility, description of scram
REACTOR FUEL ELEMENTS — temperature distribution in Fast Flux Test Facility, analysis of; assemblies of Fast Flux Test Facility, fabrication of
NEUTRONS, FAST — spectra calculations for Fast Test Reactor tube sheet, description of
FAST TEST REACTOR — tube sheet of, fast neutron spectra calculations for
RADIATION TARGET CANS — configuration of Fast Test Reactor driver fuel testing
REACTOR EXPERIMENTAL FACILITIES — sampling system for Fast Flux Test Facility, description of liquid sodium
STAINLESS STEEL — radiation effects on Type 304, analysis of fast neutron
NEUTRONS, FAST — effects on Type 304 stainless steel, analysis of
SODIUM — sampling system for liquid, description of Fast Flux Test Facility experimental facility (D.C.C.)

4301 (BNWL-894) NUCLEAR SAFETY QUARTERLY REPORT, MAY-JULY 1968 FOR NUCLEAR SAFETY BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1968. Contract AT(45-1)-1830. 107p. Dep. CFSTI.

REACTOR SAFETY — containment vessel leakage; effects of temperature and pressure on; waste disposal methods for fast reactor fuels, description of
REACTOR CONTAINMENT STRUCTURES — leakage from, effects of temperature and pressure on

REACTORS, PRESSURIZED-WATER — coolant loss accident simulation for, effects of pressure and temperature on containment vessel leakage in
METHANE, IODO — washout rate for, effects of spray chamber size on
SPRAY COLUMNS — performance of, effects of size on methyl iodide washout rate
ULTRASONIC INSPECTION — configuration of stainless steel failure detector for, description of
RADIOACTIVE WASTE — solidification processes for, description of PW-1 and Pw-4m
FISSION PRODUCTS — abundance in fast reactor irradiated fuels, effects of cooling time on (D.C.C.)

4302 (BNWL-SA-1323) GEOMETRY PROBLEMS ENCOUNTERED IN DESIGN OF THE FFTF SPLIT CONICAL CORE. Finch, L. M.; Peterson, R. E.; Waymire, G. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 9, 1967. Contract AT(45-1)-1830. 36p. (CONF-671102-45). Dep. CFSTI.

From 15th Conference on Remote Systems Technology and Atom Fair, Chicago, Ill.

The conceptual designs for the Fast Flux Test Facility included vertical, skewed, and split conical core configurations. Evaluation of the proposals led to the selection of the split conical core. Core design activity after selection of the conceptual design was concerned with improving the geometry and fuel design to achieve the maximum obtainable flux. Geometric problems encountered in the optimization effort and the final selected core configuration are described. (H.D.R.)

4303 (CEA-R-3453) INTRODUCTION TO THE STUDY OF AN OPTIMAL CONTROL FOR IRRADIATION LOOPS OF THE REACTOR PEGASE. Guintrand, Claude (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). July 1968. 73p. (In French). Dep.

Thesis. Submitted to Univ., Marseille.

The control system under consideration is made up of: a regulation unit consisting of a conventional nonlinear looped circuit for static tests; and a cycling unit operating in open loop for dynamic tests. After a definition of a mathematical model for an irradiation loop, the behavior of the regulation unit is studied using three-dimensional topological methods and by analogue simulation. A prototype unit is under construction and its principal characteristics are given. The first tests involving self-instruction techniques are described for the cycling unit. (auth)

4304 (EUR-4051) SITE SURVEILLANCE WITHIN EURATOM JRC AT ISPRA. de Bortoli, M.; Gaglione, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 13, 1968. 42p. (In Italian). Dep.

The results of the site survey measurements performed within the fence of the Ispra Establishment during 1967 are reported and briefly discussed. It may be concluded that most of the contamination found on the site is due to the world-wide fallout. (auth)

4305 (EURFNR-519) CONSTRUCTION AND PERFORMANCE OF SNEAK REACTIVITY METER. Walze, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Translation of report KFK-739. 36p. (EUR-3722). Dep. CFSTI.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The RM described is a simple and sensitive reactor monitoring device which can be used to ascertain reactivity changes quickly. Its characteristic time constant is approx. 25 ms if output signal equalization is dispensed with and a delay-free recording device is connected up. The remaining defects can be eliminated by using different C_i condensers and a better multiplier. With these improvements, the RM would be a reliable reactivity measurement system as well as a monitoring device. (auth)

4306 (EURFNR-520) RAPSODIE: SECOND TYPE CONTROL ROD MECHANISM TESTS OF SECONDARY SEALING BARRIER. Jacquelin, R.; Pineau, C. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires. Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated from report DRP/SEMTR/CAD-68-R-565. 18p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Tests of bellows made with Neoprene are reported. The bellows are to be used in a control rod mechanism of reactor Rapsodie. Their function is secondary sealing. Primary sealing is by metallic bellows. Tests up to 80°C were run satisfactorily with bellows which were fitted with a special metallic ring in order to prevent radial expansion. (auth)

4307 (EURFNR-565) URANIUM REACTION RATE MEASUREMENTS IN THE STEAM-COOLED FAST REACTOR SNEAK, ASSEMBLY 3A-2. Boehme, R.; Seufert, H. (Kernforschungszentrum, Karlsruhe (West Germany)). June 1968. 43p. (EUR-3970; KFK-811). Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Uranium reaction rate traverses as well as their fine structure have been measured at the Karlsruhe Fast Zero Power Reactor SNEAK assembly 3A-2. For this purpose U metal foils were irradiated in the reactor. The γ-x-ray coincidence technique was applied to determine the relative capture rates in ^{238}U. To get absolute rates by this method the counting equipment was calibrated by a ^{243}Am source. The relative fission rates were obtained by integral counting of the fission product γ-activity above 660 keV γ-energy. These rates were linked to an absolute parallel plate fission chamber experiment. The experimental rate ratios were compared with calculated ones. The traverse measurements indicate a strong dependency of the axial "buckling" (relative second derivative of the rates) on energy. The calculations with the Karlsruhe SNEAK-set yield these bucklings in the average 5% higher than measured. The calculated fission rate ratio $\sigma_f^{28}/\sigma_f^{25}$ is 13 to 20% lower than the measured one depending on the heterogeneity of the core, but the capture to fission rate ratio agrees better with the measurement. (10 references.) (auth)

4308 (IN-1179) A PRIMARY STUDY ON THE COMPRESSIVE PROPERTIES OF COMPOSITE NUCLEAR FUEL PLATES. Sumpter, K. C. (Idaho Nuclear Corp., Idaho Falls). Apr. 1968. Contract AT(10-1)-1230. 22p. Dep. CFSTI.

Compression stress-strain curves for Advanced Test Reactor composite, Al fuel plates are given for room temperature, 250 (121), 300 (149), 350 (177), 400 (204), 450 (232), and 500°F (260°C). A comparison between 6061-0 Al and the composite compressive yield strengths indicated significant strengthening affected by the core material. This effect is reflected in Young's modulus above 300°F. A description of the apparatus used, including the subpress assembly, is given. Also discussed are some problems encountered with this hardware and some probable solutions. A mechanism is discussed with respect to the strengthening by mechanical interaction of the fuel particles on the matrix. 14 references. (auth)

4309 (IN-1245) HEAT TRANSFER IN THE MTR CORE. Little, W. S. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 15, 1964. Contract AT(10-1)-205. 50p. Dep. CFSTI.

The methods used and the basic data available for calculating the heat transfer conditions in the MTR core are presented. Correlations and graphs are presented for estimating the average axial thermal neutron fluxes in fuel elements and fueled shim rods, and for estimating the vertical thermal neutron maximum-to-average ratio for various shim rod positions. A standard hot spot-hot channel analysis and statistical hot spot temperature and heat flux analysis are presented. The maximum heat transfer conditions in the MTR are calculated. Thermal neutron flux data and heat transfer conditions for two special loadings not normally used in the reactor are also presented. (TSS) (auth)

4310 (IN-1250) FINDINGS ON CHLORIDE STRESS CORROSION IN THE MTR AND ETR PRIMARY SYSTEMS. Wadkins, R. P. (Idaho Nuclear Corp., Idaho Falls). Aug. 1966. Contract AT(10-1)-1230. 20p. Dep. CFSTI.

The Materials Testing Reactor and Engineering Test Reactor have operated 13 years and 9 years, respectively, with no apparent chloride stress corrosion. Three different austenitic stainless steels are used in the test reactors, 347 in the MTR with 304 L and 304 being used in the ETR. Inspection of pipe samples from both systems show no corrosion. Dye penetrant checks in the area around nozzles in the ETR vessel show no stress cracks. (auth)

4311 (IN-1254) RECENT RESEARCH ON THORIUM AT THE MATERIALS TESTING REACTOR. Nisle, Robert G. (Idaho Nuclear Corp., Idaho Falls). Sept. 1968. Contract AT(10-1)-1230. 45p. Dep. CFSTI.

The concept of a composite equilibrium, analogous to the "transient equilibrium" of Evans, is developed and shown to be useful for continuous irradiations. The sensitivity of its value to cycled irradiations and its limitations under conditions of randomly interrupted irradiations are pointed out. Problems of flux level and spectrum measurement during irradiation are discussed and areas where improvements are needed are indicated. A sizeable portion of the effort was devoted to the development of calculational techniques for the interpretation of the data. These involve adjustment of results to account for effects that could not be measured directly, but could be inferred from reactor core type calculations. Still other calculational techniques deal with

calibration of reactivity response versus sample content and prediction of reactivity changes during ^{233}Pa decay. These in themselves constitute a contribution to the art aside from the validity of the numerical results obtained. 26 references. (auth)

4312 (KURRI-TR-39) REPORTS ON JOINT RESEARCH WORKS AT KYOTO UNIV. RESEARCH REACTOR INSTITUTE FOR THE FIRST HALF OF FISCAL 1966. (Kyoto Univ. (Japan). Research Reactor Inst.). 1967. 156p. (In Japanese). Dep.

Some 70 brief reports are given on joint research works at the KURRI covering the period from April to September 1966. They include the following: radiation damages and other effects, various activation analyses (medicine, biology, agriculture, etc.), biological and medical researches in various phases, γ-ray and neutron spectrometry, rare-earths separation, radiation polymerization, glass and crystal coloration, cross section measurements, radiation dosimetry, labelled compounds and radioisotope production, U and Th analyses, transuranium-elements fission, solidstate physics, linear energy transfer (LET) effects, and nuclear structure. (NSA of Japan)

4313 (KURRI-TR-46) TABLES OF REACTOR POISONING DUE TO FISSION PRODUCTS. Nanjyo, Tsutomu (Kyoto Univ. (Japan). Research Reactor Inst.). Mar. 15, 1968. 52p. (In Japanese). Dep.

Reactivity changes due to ^{135}Xe and other fission products are tabulated. The calculation of the neutron flux shape function and the adjoint function are illustrated. For reactors with thermal neutron flux of from 10^{11} n/cm^2 sec to $10^{15.9}$ n/cm^{2}sec, the change of χ from starting up of the reactor is tabulated. Also the change of χ from shutdown of the reactor in a state of equilibrium is tabulated. The change of χ caused by changing the neutron flux level to from 10 to $^1/_{10}$ times of initial level is described. The reactivity change due to fission products other than ^{135}Xe is illustrated. The quantity corresponding to χ in ^{135}Xe is tabulated for the time from starting up of the reactor. (auth)

4314 (LA-3934) NEUTRON FLUX MEASUREMENTS IN URANIUM METAL EXPONENTIAL COLUMNS OF 6.53 PERCENT AND 9.12 PERÇENT ^{235}U. Steinke, R. G. (Los Alamos Scientific Lab., N. Mex.). Jan. 1968. Contract W-7405-eng-36. 11p. Dep. CFSTI.

Material bucklings measured in the equilibrium neutron spectra of heterogeneous uranium metal exponential columns containing 9.12‰ and 6.53‰ ^{235}U are reported. These results of exponential-column measurements are compared with values computed by means of Hansen-Roach cross sections. Through application of a fine-structure insert in the equilibrium spectral region of each column, fission cross-section ratios are structure-averaged. The measured spectral indices are given. (auth)

4315 (NP-17462) REPORT ON SESSION 1966-1967. Wilson, H. W. (Scottish Research Reactor Centre, East Kilbride (Scotland)). Jan. 1968. 12p. (SRRC-27/68). Dep.

Utilisation of the Reactor Center for research and teaching is reviewed, and mention is also made of the Isotope Geology Unit. A list of publications by the staff is included. (UK)

4316 (NP-17597, pp 151-65) TECHNICAL SUPPORT FOR RESEARCH. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — research activitfes on research reactors, electronics, computers, and analytical chemistry, 1967 summary of
REACTORS, RESEARCH — operation of French, 1967 summary of
REACTORS, FRANCE — operation of research, 1967 summary of
ELECTRONICS — development of nuclear, 1967 summary of French activities in
COMPUTERS — development in France, 1967 summary of
CHEMISTRY — research on analytical, 1967 summary of French (H.D.R.)

4317 (ORNL-TM-2187) 05R MONTE CARLO CALCULATIONS OF LOW-ENRICHED URANIUM THERMAL CRITICAL ASSEMBLIES, AND EVIDENCE OF ERRORS IN ^{238}U CROSS SECTIONS. Webster, J. Wallace (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 154p. Dep. CFSTI.

As criticality calculation methods have become more exact and capable of utilizing cross sections in all their detail, instead of in the form of integral values such as age and resonance escape probability, evidence has been growing that the computed multiplication factors, k_{eff}, of low-enriched U thermal systems are low compared to experiment. This discrepancy occurs when the Monte Carlo method is used together with point-set representations of the cross sections. Considerable analysis was devoted to the representation of the ^{238}U cross sections with point sets of data and the results are presented by Calcomp plots of cross section vs neutron energy and tables of the resonance integrals. The critical experiments chosen for comparisons with computations were all unreflected, homogeneous, and representative of a broad range of resonance capture in ^{238}U. A definite pattern emerged from these comparisons; namely, the greater the neutron capture in ^{238}U, the lower the computed k_{eff}. The evidence of errors in the cross sections of ^{238}U or their representation, previously noted by others, is thus strengthened. (auth)

4318 (PEL-170) SAFETY REPORT ON THE PELINDUNA CRITICAL EXPERIMENTS. De Villiers, J. W. L. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Feb. 1968. 35p. Dep.

The PELINDUNA-0 critical facility which is under construction at Pelindaba is described. The first reactor system to be investigated in this facility is also described and an assessment of the hazards associated with the planned experiments is given. The core of the first system will consist of 4 elements of the PELINDUNA design, enriched to 2% in ^{235}U. These elements will be arranged in a square or triangular pattern at various lattice pitches in heavy water inside a 1.6 m dia. tank. Four control rods will be provided. A 20 cm dia. dump valve serves as an additional safety device. Although the PELINDUNA system is a heavy water moderated, Na-cooled reactor, no Na will be allowed in the critical facility. This ensures a negative temperature coefficient, due mainly to the Doppler effect in the fuel. The design, construction and safety instrumentation for the critical assembly conform to general practice in the operation of critical assemblies. The reactor is completely self-limiting for a $1 excess reactivity step with no hazard to the general public. This will probably also apply for a $2 step, while the public hazard remains extremely small. (auth)

4319 (ZFK-132) 10 YEARS RFR-5 YEARS RRR: A BACKWARD GLANCE AT THE WORK ON THE ROSSENDORF RESEARCH REACTOR. Adam, E.; Klebau, J. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). Dec. 1967. 74p. (In German). Dep.

A detailed summary of the 10 years operation of the Rossendorf Research Reactor is given; the reactor is described briefly. Use of the reactor as a reactor physics research tool is summarized. Nuclear physics work at the reactor is discussed; radiation effects studies on dense substances are summarized. Neutron diffraction work at the reactor is described; some results are given. Neutron activation analysis and isotope production are discussed. The Rossendorf zoned reactor is described; an operations history is given. 108 references. (M.L.S.)

4320 PHYSICS RESEARCH REACTORS PARAMETERS. Erykalov, A. N.; Petrov, Yu. V. At. Energ. (USSR), 25: 52-4 (July 1968). (In Russian).

The actual product of a physical research reactor consists of pulses in the experimental instrumentation. When evaluating the economic efficiency of the operation, the productivity and cost per pulse must be also considered. The size of the irradiated specimens is usually small and only a relatively small portion of the neutrons are actually captured. The productivity, expressed as the number of pulses in the instruments, is determined by the sum of the yields of all of the beamholes used for experiments. When the power level is increased, the capital cost and operational expenses increase more slowly than the power and their contribution to the overall cost decreases. The neutron generation cost of reactors with a rating of tens or hundreds of MW depends primarily on the fuel cost. In the calculations presented it was assumed that the value of the information obtained remains the same in every case. (TTT)

4321 A PROGRAM OF INTERNATIONAL COOPERATION BETWEEN THE PHILLIPPINE ATOMIC ENERGY COMMISSION AND THE UNIVERSITY OF VIRGINIA. Ibe, Librado D. (Phillippine Atomic Energy Commission, Manila); Johnson, W. Reed. Trans. Amer. Nucl. Soc., 11: 437 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4322 MEASUREMENT OF THE NEUTRON AND GAMMA DOSE IN A NUCLEAR REACTOR. Bley, W. N.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 463 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4323 EFFECT OF FUEL CONCENTRATION ON THE COMPRESSIVE STRENGTH OF CORE MATERIALS USED IN RESEARCH REACTOR FUEL PLATES. Erwin, J. H.; Martin, M. M.; Martin, W. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 490 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4324 DEVELOPMENT OF BORON–ALUMINUM FOILS AS NEUTRON ABSORBERS IN TEST REACTOR FUEL ELEMENTS. Gibson, G. W.; Graber, M. J.; Marchbanks, M. F.; Francis, W. C. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 11: 487 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4325 FFTF DRIVER FUEL DEVELOPMENT IRRADIATIONS. Roake, W. E.; Hayward, B. R.; Hanson, J. E.; Pember, L. A.; Weber, J. W.; Culley, G. E. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 513-14 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4326 IRRADIATION BEHAVIOR OF PLUTONIUM MIXED-OXIDE DRIVER FUEL OF RAPSODIE. Anselin, F. (CEA, Fontenay-aux-Roses, France); Mas, R. G.; Mustelier, J. P. Trans. Amer. Nucl. Soc., 11: 514-15 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4327 TIME-DEPENDENCE OF FINITE, SUBCRITICAL FAST MULTIPLYING ASSEMBLIES. Dorning, J.; Nicolaenko, B. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 577-8 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4328 AN ON-LINE REACTIVITY METER BASED ON REACTOR NOISE USING TWO-DETECTOR CROSS CORRELATION. Seifritz, W.; Stegemann, D. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 565-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4329 COMPUTER-AIDED CALIBRATION OF A FINE AUTO-ROD. Cohn, C. E.; Karam, R. A.; Marshall, J. E.; van Doorninck, J. M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 566-7 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4330 SHUTDOWN REACTIVITY MEASUREMENTS AT THE ORR USING NOISE ANALYSIS. Penland, J. R.; Hanauer, S. H. (Univ. of Tennessee, Knoxville). Trans. Amer. Nucl. Soc., 11: 563-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4331 ORDER-OF-SCATTERING EXPANSIONS FOR CRITICAL SYSTEMS. Mingle, J. O. (Kansas State Univ., Manhattan). Trans. Amer. Nucl. Soc., 11: 550-1 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4332 SPACE-TIME STUDY OF A PULSED REACTOR. Sears, C. Frederick (Combustion Engineering, Inc., Windsor, Conn.); Kenney, E. S. Trans. Amer. Nucl. Soc., 11: 583 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4333 CORE-DISPLACEMENT REACTIVITY COEFFICIENT OF A FAST-PULSE REACTOR. Kurstedt, H. A. Jr.; Kazi, A. H.; Gazillo, V. E. (Ballistic Research Lab., Aberdeen Proving Ground, Md.). Trans. Amer. Nucl. Soc., 11: 583-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4334 FLUXES INTRASTRUCTURE IN A LARGE, PLATE-TYPE HETEROGENEOUS UO_2 FAST CORE (ASSEMBLY-6, ZPR-6). Karam, R. A.; Marshall, J. E.; Nakamura, T. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 598-9 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4335 MEASUREMENT OF REACTION RATIOS AND NEUTRON SPECTRA IN A SOFT-SPECTRUM FAST REACTOR. Kato, W. Y. (Argonne National Lab., Ill.), Preskitt, C. A.; Young, J. C.; Neill, J. M.; Swanson, C. D.; Armani, R. J.; Roberts, J. H. Trans. Amer. Nucl. Soc., 11: 599 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4336 ANALYSIS OF FIVE PLUTONIUM-FUELED FAST REACTOR CRITICAL ASSEMBLIES. Specht, E. R. (Atomics International, Inc., Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 599-601 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4337 ANALYSIS OF FAST CRITICAL ASSEMBLIES AND LARGE FAST POWER REACTORS WITH GROUP-CONSTANT SETS RECENTLY EVALUATED AT KARLSRUHE. Eisemann, E.; Kuesters, H.; Metzenroth, M.; Schmidt, J. J.; Schroeter, K. E.; Thiem, D. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 601-2 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4338 ANALYSIS OF SODIUM VOID MEASUREMENTS IN FAST CRITICAL ASSEMBLIES WITH ENDF/B AND MODIFIED ENDF/B DATA. Pitterle, T. A.; Page, E. M.; Yamamoto, M. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 11: 602-3 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4339 MONTE CARLO CALCULATIONS OF TWO-CORE DELAYED CRITICAL ASSEMBLIES. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc., 11: 603-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4340 AN ANALYSIS OF SOME UNIFORM LATTICE TEMPERATURE COEFFICIENT EXPERIMENTS. Uotinen, V. O.; Jenquin, U. P. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 588-9 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4341 LATTICE STUDIES OF CLUSTERS OF UO_2 FUEL PINS. Mitsui, H.; Kikuchi, H.; Yamamoto, K.; Haga, T.; Wajima, J. T. (Hitachi Ltd., Kanagawa, Japan). Trans. Amer. Nucl. Soc., 11: 589-90 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4342 ACCURACY OF POWER-DISTRIBUTION CALCULATION METHODS FOR URANIUM AND PLUTONIUM LATTICES BASED ON RECENT EXPERIMENTS AND ENEL REACTOR OPERATING DATA. Ariemma, A.; Lesnoni, G.; Gualandi, M. Paoletti; Peroni, P.; Zaffiro, B. (ENEL-DCTN, Rome). Trans. Amer. Nucl. Soc., 11: 590-1 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4343 EFFECTS OF FUEL AND EXPERIMENT FAILURES UPON TEST REACTOR OPERATIONS. Keller, F. R. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 11: 625 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4344 NOISE ANALYSIS, AN ATR STARTUP SURVEILLANCE PROGRAM. Willis, J. B. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 11: 625-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4345 APPLICATION OF TODAY'S MATERIALS STUDIES TO TOMORROW'S OPERATION OF RESEARCH REACTORS. Martin, W. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 626-7 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4346 COINCIDENCE TECHNIQUES IN HFIR EXPERIMENT PROTECTION. Asquith, D. S.; Burton, C. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 627 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4347 MEASUREMENT AND REDUCTION OF FLOW FLUCTUATIONS IN A HEAVY-WATER-COOLED MTR. Panter, R. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Trans. Amer. Nucl. Soc., 11: 627-8 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4348 SILOE: ITS OPERATION, HISTORY, AND PROBLEMS. Jacquemain, M.; Rossillon, M. (CEN, Grenoble, France). Trans. Amer. Nucl. Soc., 11: 628 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4349 SIGNIFICANT EXPERIENCES OF THE NASA PLUM BROOK REACTOR FACILITY. Barkley, H. B. Jr. (Lewis Research Center, Sandusky, Ohio). Trans. Amer. Nucl. Soc., 11: 628-9 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4350 EXPERIMENT USAGE DEVELOPMENT OF THE AIR FORCE NUCLEAR ENGINEERING REACTOR. Buoni, F. B.; Fasano, A. N.; Gwynn, P. S. (Wright Patterson Air Force Base, Ohio). Trans. Amer. Nucl. Soc., 11: 629-30 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4351 STUDY ON CONVERSION OF TREAT FACILITY FOR TESTING OF FAST REACTOR SUBASSEMBLIES. Iskenderian, H. P. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 643-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4352 THE USE OF XENON POISONING FOR MEASUREMENTS OF REACTOR PARAMETERS. Rada, G.; Coello, E.; Ollarves, H. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Trans. Amer. Nucl. Soc., 11: 649 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4353 EXPERIENCE WITH BERYLLIUM SWELLING AND REPLACEMENT IN THE PLUM BROOK REACTOR. Fecych, William (Lewis Research Center, Sandusky, Ohio). Trans. Amer. Nucl. Soc., 11: 649-50 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4354 DEVELOPMENT OF A FAMILY OF ANNULAR LINEAR INDUCTION PUMPS FOR USE IN FAST REACTOR SAFETY INTEGRAL-LOOP EXPERIMENTS. Robinson, L. E.; Carlson, R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 639 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4355 EXPERIMENTS ON SNEAK USING THE METHOD OF PROGRESSIVE SUBSTITUTION FOR CRITICAL MASS DETERMINATION IN FAST SYSTEMS. Helm, F. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 595 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4356 VERIFICATION OF ZONED FAST CRITICAL ASSEMBLIES. LeSage, L. G. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 595-7 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4357 A 4000-LITER URANIUM-OXIDE FAST CORE ASSEMBLY-6 OF ZPR-6. Karam, R. A.; Kato, W. Y.; Marshall, J. E.; Nakamura, T.; Rusch, G. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 597-8 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4358 ANALYSIS OF UO_2-2 WT PERCENT PuO_2-FUELED, D_2O-MODERATED CRITICAL EXPERIMENTS. Mannan, M. A.; Prezbindowski, D. L. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 587 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4359 USE OF MULTIPLE REGRESSION TO OBTAIN PREDICTIVE EQUATIONS FOR THERMAL-NEUTRON FLUX PERTURBATION EFFECTS IN THE PLUM BROOK REACTOR HIGH-FLUX TEST POSITIONS. Lynch, John H.; Peters, Lawrence E. Jr. (Lewis Research Center, Sandusky, Ohio). Trans. Amer. Nucl. Soc., 11: 592-3 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4360 OPERATING EXPERIENCE AND NEUTRON FLUENCE CHARACTERISTICS OF THE WHITE SANDS MISSILE RANGE FAST BURST REACTOR. De La Paz, A.; Welch, D. L.; Luera, T. F.; Parkyn, J. D. (White Sands Missile Range, N. Mex.). Trans. Amer. Nucl. Soc., 11: 645-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4361 CALCULATION OF DELAYED-NEUTRON MULTIPLICATION IN THIN SUBCRITICAL SYSTEMS. Lee, Clarence E.; Masters, Christopher F. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc., 11: 662-3 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4362 ANALYSIS OF REFLECTED ORALLOY CRITICAL EXPERIMENTS. Cohen, S. C. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 671 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4363 CALCULATED FISSION YIELD FROM REACTIVITY ADDITIONS TO AN ASSEMBLY OF LONG, THIN FUEL RODS. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc., 11: 669-70 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4364 AGING BEHAVIOR OF FISSION PRODUCTS RELEASED BY IN-PILE MELTING OF UO_2. Roberts, B. F.; Freid, S. H.; Sisman, O. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 666-7 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4365 POSITION-DEPENDENT NEUTRON SPECTRA IN A TIGHT LATTICE OF SMALL URANIUM RODS. Trimble, G. D.; Gozani, T.; Neill, J. M.; d'Oultremont, P.; Preskitt, C. A. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 611-12 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4366 IRRADIATION OF GRAPHITE IN HFIR. Kennedy, C. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 11: 623-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4367 TIME-OPTIMAL DIGITAL CONTROL OF ZERO-POWER NUCLEAR REACTORS. Marciniak, Thomas J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 633 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4368 RECENT EXPERIMENTAL CRITICALITY SAFETY DATA OBTAINED IN FRANCE: CORRELATION WITH CALCULATIONS: PLANNED EXPERIMENTAL PROGRAM. Lecorche, P. R. (CEA, Paris). Trans. Amer. Nucl. Soc., 11: 687 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4369 DEVELOPMENT OF CRITICALITY DATA FOR NUCLEAR SAFETY PURPOSES. Chalmers, J. H. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). Trans. Amer. Nucl. Soc., 11: 687-8 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4370 CRITICALITY RESEARCH AT PACIFIC NORTHWEST LABORATORY. Bierman, S. R.; Clayton, E. D. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 688-90 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4371 FFTF CORE INSTRUMENTATION BASES AND REQUIREMENTS. Padilla, A. Jr.; Peterson, R. E.; Regimbal, J. J. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 693-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4372 CRITICALITY HAZARDS CONTROL FOR ZPPR FUEL. Amundson, P. I.; Matlock, R. G.; Forrester, R. J.; Young, J. C.; Gasidlo, J. M. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 673-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4373 EFFECT OF UNIT CELL SHAPE VARIATION IN A CRITICAL ARRAY OF PLUTONIUM METAL PARTS. Finn, H. F.; Pierce, G. A.; Pruvost, N. L.; Pefley, G. V. Jr. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 674 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4374 CRITICAL LATTICES OF U(4.89) RODS IN WATER AND IN AQUEOUS BORON SOLUTION. Johnson, E. G. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc., 11: 674-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4375 APPROACH-TO-CRITICAL BY MODAL ANALYSIS FOR PLUTONIUM-FUELED SYSTEMS. Olson, Arne P.; Palmer, R. G. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 675-6(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4376 SURFACE HEAT TRANSFER IN RAPID TRANSIENTS. Friis, R. W.; Miller, L. E. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 11: 678-9(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4377 TRANSIENT IRRADIATION OF STAINLESS-STEEL-CLAD OXIDE FUEL RODS IN THE REGION OF PROMPT FAILURE. Stephan, L. A.; McClure, J. A.; Siefken, L. J. (Phillips Petroleum Co., AED, Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 679-81(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4378 METAL-WATER REACTIONS RESULTING FROM TRANSIENT IRRADIATIONS IN THE CAPSULE DRIVER CORE. Olsen, C. S.; Johnson, R. L. (Phillips Petroleum Co., AED, Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 11: 681(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4379 FAST NEUTRON SPECTRA MEASUREMENTS IN THE TEST HOLE OF IRT-2000 REACTOR. Lapenas, A. A.; Baltmugur, K. K.; Krikis, Yu. Yu. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser., No. 4, 32-9(1968). (In Russian).

The measurements are carried out using the method of threshold detectors in a horizontal test hole of an IRT-2000 reactor. Absolute activity of the indicators is measured by a γ-scintillation spectrometer with $\pm 8\%$ accuracy. Numerical processing of the experimental data is carried out by means of the Uthe method. Data of fast neutron energy distribution according to which the effective cross-sections for various effective thresholds are calculated are also obtained. (auth)

4380 BEHAVIOR OF THE NEUTRON TEMPERATURE DURING A POWER PULSE OF THE TRIGA MARK II REACTOR. Fleck, C. M.; Meisterl, J. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 13: 397-400(Nov.-Dec. 1968). (In German).

The neutron temperature during a power pulse at a TRIGA-reactor was measured by foil detectors. The use of Dy with its great Cd-ratio permits the determination of the Cd-difference of the foil arrangement in a single activation process by arranging several foils and filters in series. The variation of the core-temperature is calculated by using the Fuchs–Nordheim-model. For this the specific heat of the core was determined with a temperature dependent set up. To evaluate the variation of the neutron temperature, a simple linear relation is assumed between the neutron temperature and the core temperature. The constant of proportionality for this is determined as the mean value over the pulse, which can be described as a linear function of the released energy. For the neutron temperature, too, mean values over the pulse are given, which can be described as a linear function of the maximum reactor power during the pulse, where the reactor power is the weight function of the averaging process. (auth)

4381 IN PILE AUTOCLAVE CAPSULE FOR CORROSION TESTS IN WATER AT 320°C AND 115 ATM. Spalthoff, W.; Wilhelm, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie, 13: 394-6(Nov.-Dec. 1968). (In German).

An irradiation rig for corrosion testing core materials for water cooled power reactors is described. The rig is designed for insertion in the swimming pool reactors FRG-1 or FRG-2. The irradiation facility consists of a pressure-proof autoclave which contains water of reactor quality and the corrosion specimens, a safety capsule which encloses the autoclave, and an instrumentation which is installed in a rack beside the pool. Capsule and instrumentation rack are connected by a flexible metal-hose, which contains the supply leads. The autoclave is made of 18/8 CrNi-steel code no. 4571. The over all length, the outer diameter and the wall thickness are 1000 mm, 63 mm and 6 mm respectively. Design pressure and temperature are 150 at and 350°C. The autoclave is closed by welded-on top and bottom caps. The safety capsule is made of the Al alloy AlMg3, the design dates are 150 at and 200°C. Between autoclave and safety capsule is an 0.8 mm gas gap filled with He. The capsule occupies the place of one MTR-fuel element. The test temperature in the autoclave is reached by γ heating plus a variable heat supply from the electrical heater which is installed in the lower part of the autoclave. The test temperature is controlled by thermocouples. Additionally the autoclave is connected with the instrumentation via three capillaries, which permit pressure control and periodic water exchange. The volume of the autoclave available for specimens is about 0.5 l. By a guide tube a natural water convection is produced in the autoclave. The water velocity at the specimens can be calculated and amounts to a few cm per sec. The irradiation rig is equipped with a safety instrumentation which excludes dangerous temperature- or pressure-increases. (auth)

4382 CRITICALITY MEASUREMENTS ON NEARLY HOMOGENEOUS ENRICHED URANIUM–GRAPHITE SYSTEMS. Phelps, James P.; Weinstock, Eugene V. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 34: 237-50(Dec. 1968).

Accurate critical parameters have been obtained for bare, nearly homogeneous assemblies of enriched U and graphite having C/U atom ratios in the range 960 to 23,000. Among the quantities measured were k_{eff}, critical bucklings, extrapolation distances, spectral indices, and neutron lifetimes. Particular attention was paid to the problem of neutrons returning from the surroundings. 33 references. (auth)

4383 ANALYSIS OF BROOKHAVEN ^{235}U–GRAPHITE CRITICAL EXPERIMENTS. Sehgal, Bal Raj (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 34: 251-62(Dec. 1968).

Analysis of nearly homogeneous enriched U–graphite critical assemblies is given. These assemblies are characterized mainly by their high leakage rate, and two methods are used for estimating the leakage: the conventional B_1 approximation method and the moments method using Monte Carlo calculations for the moments of the slowing down distribution. It is found that the B_1 approximation describes the leakage effects quite accurately. Most of the cross sections used in the calculations are from the recent evaluated nuclear data file (ENDF/B). Results of calculations for k_{eff}, neutron lifetimes, and foil activation ratios are generally in excellent agreement with the measurements. 32 references. (auth)

4384 ANALYSIS OF A SET OF CRITICAL HOMOGENEOUS U–H_2O SPHERES. Staub, Alan; Harris, D. R.; Goldsmith, Mark (Westinghouse Electric Corp., West Mifflin, Pa.). Nucl. Sci. Eng., 34: 263-74(Dec. 1968).

A group of 11 aqueous critical experiments fueled by ^{233}U and ^{235}U and performed by Gwin and Magnuson have been analyzed to serve as integral tests of nuclear data important in reactor design. Measured eigenvalues were corrected for various effects including the presence of the Al container, departures from sphericity, delayed-neutron importance, and room return. Eigenvalues were calculated in simplified P-3 approximation using 60 energy groups, and determinations were made of the eigenvalue uncertainties associated with this treatment. Within the eigenvalue uncertainties resulting from fuel inventories, it was concluded that fissile nuclide and H(n,γ) cross sections were adequate to match calculations and experiments but that there was evidence of erroneous nuclear data important in determining neutron leakage. In particular, a substantially harder ^{233}U fission neutron spectrum seems to be indicated. 40 references. (auth)

4385 MEASUREMENT OF THE REACTIVITY OF A SUBCRITICAL SYSTEM. Olarte, F. J. (Junta de Energia Nuclear, Madrid). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 177-82(May-June 1967). (In Spanish).

The reactivity of a heavy water-natural uranium carbide subcritical system is measured with the pulsed source technique for several detector positions. Both $k\beta/l$ and Gozani's calculation methods are used. The calculated reactivity is dependent on the detector position. This dependence is more apparent in Gozani's method. 11 references. (auth)

4386 PULSED NEUTRON REACTIVITY MEASUREMENTS. Olarte, F. J. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid), 12: 249-60(May-June 1968). (In Spanish).

The various methods of determining time-dependent thermal neutron flux in pulsed reactors are reviewed. Thermal flux is shown as a function of time; variation of the decay constant with geometric buckling is presented graphically. Reactivity calculations are tabulated. 40 references. (M.L.S.)

4387 JEN-2 REACTOR. B. MEASUREMENTS CARRIED OUT. Montes Ponce de Leon, J.; Martin Nuno, C.; Alcober Bosch, V.; Diez Moreno, J. E. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid), 12: 214-23(May-June 1968). (In Spanish).

Initial testing of the JEN-2 reactor is summarized. Rod drop testing is described; experimental apparatus and results are discussed. Data are shown graphically; drop times are shown as a function of magnet current and rod height. Core loading diagrams are given; inverse multiplication curves are shown as a function of number of fuel elements. Control rod calibration procedures are outlined; data are shown graphically. Neutron flux profiles are given for the core. (M.L.S.)

4388 BERYLLIUM-FILTERED NEUTRON BEAM QUALITY IMPROVEMENT AT A POOL REACTOR THROUGH CORE ELEMENT REARRANGEMENTS. Antal, J. J.; Warnas, A. A. (Army Materials and Mechanics Research Center, Watertown, Mass.). Nucl. Instrum. Methods, 65: 125-31(Nov. 1, 1968).

Neutron spectra in the region of 4 to 7.5 Å from a radial beam tube have been obtained for various fuel and BeO reflector arrangements in the Army Materials Research Reactor. Intensity and signal-to-noise ratio variations in the range of 15 to 20% have been obtained through rearrangement of core elements immediately adjacent to the beam tube termination. In general, the results indicate that the experiment external to the reactor should view reflector element material only at the core face, and this reflector material should be surrounded by fuel for the most favorable intensity and signal-to-noise ratio combination. (auth)

Rocket and Space Reactors

Refer also to abstracts 2487, 2511, and 3091.

4389 (LA-DC-9620) AN INTEGRATED CIRCUIT CONTROL SYSTEM FOR THE PEWEE REACTOR. Strait, Bobby G.; Lang, Robert M. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 7p. (CONF-681017-2). Dep. CFSTI.

From 15th Nuclear Science Symposium, Montreal, Canada.

A control system utilizing digital and linear integrated circuits was developed for low power testing of the Rover reactor, PEWEE. The control rod actuator employs electric stepping motors which are geared down to provide 0.01° resolution to the reactor rotary control rods. The system was designed to provide precision positioning capability for the control rods and features operating ease and versatility which minimizes the time and effort required to execute experiments. (auth)

4390 (N-68-27003) NUCLEAR THERMIONIC SPACE POWER CONCEPT USING ROD CONTROL AND HEAT PIPES. Anderson, John L.; Lantz, Edward (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1968. 37p. (NASA-TM-X-52446). CFSTI.

A nuclear reactor space power system using out-of-pile thermionic diodes, heat pipes, and a dual central rod type of reactivity control was investigated. Emphasis is on the neutronic aspects and general feasibility of the concept. In this concept heat is transferred from the reactor core to the thermionic diodes by layers of radial heat pipes stacked alternately with slabs of fuel. For this out-of-pile concept, which would supply 130 kW(e), the reactor can be considerably smaller than the equivalent reactor with in-pile diodes, when used with a shadow shield. (auth) (STAR)

4391 (N-68-27231) ARE GAS-CORE NUCLEAR ROCKETS ATTAINABLE. Ragsdale, Robert G. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1968]. 9p. (NASA-TM-X-52435; CONF-680609-4). CFSTI.

From AIAA 4th Propulsion Specialist Conference, Cleveland, Ohio.

In order to evaluate an advanced nuclear engine concept, it must be compared with other concepts and with engine requirements. A way to make such comparisons for open-cycle, gaseous-fueled nuclear rocket engines is described. Engine requirements are expressed in terms of two parameters. One parameter is the fraction of the engine cavity volume that is occupied by gaseous nuclear fuel. The other parameter is the ratio of mass flow rates, hydrogen-to-uranium, that is entering (and, therefore, leaving) the engine. These parameters are used to define engine performance goals and to compare experimental data for existing concepts. (auth) (STAR)

4392 ANALYSIS OF ADVANCED FAST-SPECTRUM HEAT SOURCES FOR SPACE APPLICATION. McCauley, Edward W.; Brown, Norman J. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 432-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4393 REACTIVITY SELF-CONTROL ON POWER AND TEMPERATURE IN REACTORS COOLED BY HEATPIPES. Hampel, Viktor E.; Koopman, Ronald P. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc., 11: 433-4(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4394 RADIANT HEATING OF PROPELLANT IN THE GASEOUS CORE NUCLEAR ROCKET. Shenoy, A. S.; Williams, J. R.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc., 11: 428(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4395 CALCULATIONS ON A RADIANT-HEATED OUT-OF-CORE ADVANCED THERMIONIC REACTOR CONCEPT. Mayer, Morton S. (Donald W. Douglas Labs., Baltimore); Greenborg, J.; Rasor, N. S. Trans. Amer. Nucl. Soc., 11: 430-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4396 NUCLEAR ENERGY IN SPACE. Klein, Milton. Nucl. News, 11: No. 12, 31-8(Dec. 1968).

The use of nuclear power for space applications is analyzed. Both electric power generation and rocket propulsion programs utilizing nuclear power are described. Areas of discussion include: present SNAP programs, advanced power reactor systems, improved fuel forms, and nuclear rocket development. (D.C.C.)

4397 LINEAR STABILITY OF FAST SPECTRUM IN-CORE THERMIONIC REACTORS. Brehm, Richard L. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc., 11: 431-2(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Process Heat and Desalination Reactors

4398 IMPROVEMENTS IN OR RELATING TO DESALINATION PLANT. Fifield, John Arthur Richard. British Patent 1,135,132. Nov. 27, 1968. Filed Sept. 1, 1966.

REACTORS, PROCESS HEAT—desalting system for, description of heated vertical helical channel

HEAT TRANSFER SYSTEMS—desalting system for process heat reactor, description of heated vertical helical channel (D.C.C.)

4399 SELECTION OF PARAMETERS OF AN ATOMIC ENERGY PLANT WITH HIGH PRODUCTIVITY DISTILLATION OF SEA WATER. Sterman, L. S.; Mozharov, N. A.; Gubenko, V. V. Desalination, 5: 95-106(1968).

The method presented for techno-economic analysis of an atomic energy plant, generating electrical and heat energy with a pressurized water reactor, makes it possible to choose the initial steam parameters at the entrance of the turbine under different exhaust pressures. The method may be used for a power plant of any capacity. Techno-economic calculations are carried out with the method described for a nuclear dual-purpose plant with reactor capacity of 760 MW(t) and coolant pressures in the first circuit equal to 100 atm. (auth)

Marine and Portable Power Reactors

4400 PACKAGED NUCLEAR POWER. Cohn, Paul D. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 645(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Production Reactors

4401 PLUTONIUM RECYCLE FUEL EVALUATIONS AT PNL. Freshley, M. D.; Burley, T. B.; Goldsmith, Stanley (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 487-9 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

Reactor Theory

4402 (AEEW-M-677) LECTURE NOTES ON SELECTED TOPICS IN NUMERICAL METHODS IN REACTOR PHYSICS. Fayers, F. J. (Atomic Energy Establishment, Winfrith (England)). Sept. 1966. 66p. Dep. CFSTI. UK.

Presented are notes prepared as part of a set of lectures on reactor physics given at Birmingham University. The topics treated are: calculation and use of collision probabilities in reactor physics; numerical solution of the few-group diffusion equation in two-space dimensions; and numerical solution of the transport equation by the Carlson S_n-method. (H.D.R.)

4403 (BNWL-898) TOTAL ENERGY DEPOSITION RATES IN A GRAPHITE MODERATOR WITH TWO DIFFERENT FUELS. Hanson, G. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 30, 1968. Contract AT(45-1)-1830. 18p. Dep. CFSTI.

Graphite heating calculations are given for two water cooled tubular U fuel elements surrounded by graphite. Methods used for calculations are described; space and energy effects are considered. Dimensions and nuclei densities are given for the fuel elements used in the calculations. 10 references. (M.L.S.)

4404 (KURRI-TR-35) A STUDY ON THE FAST-REACTOR NEUTRON SPECTRA BY THE SCATTERING PROCESS TECHNIQUE. Inoue, Kazuhiko (Kyoto Univ. (Japan). Research Reactor Inst.). May 1967. 26p. (In Japanese). Dep.

The fast-reactor neutron spectra are described by other than the ordinary methods like that of multi-group theory. In a fast reactor, the neutrons are moderated through elastic and inelastic scattering. However, the chances that a neutron undergoes more than several inelastic scatterings, are very small. For the elastic scattering, taking into consideration all the possible processes, the neutron spectrum is expanded by the number of inelastic scatterings. Further, as an expression containing multiple inelastic scatterings, the formula is shown in which the neutron spectrum is expanded as a series of the types of multiple inelastic scatterings. Using these formulas, examples of calculation are given for certain systems. By treating the fast-reactor neutron spectrum with scattering processes, the characteristics of the formation process and the approximate formula for fast-reactor neutron spectra are described. (NSA of Japan)

4405 (N-68-28304) AXIAL POWER TAILORING TO OBTAIN CONSTANT FUEL-CENTERLINE TEMPERATURE IN A NUCLEAR REACTOR. Davison, Harry W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1968. 43p. (NASA-TN-D-4658). CFSTI.

The total-power output from a nuclear reactor can be increased by tailoring the axial-power shape if reactor power is limited by fuel-centerline temperature. The potential power gains and the axial-power shape required to obtain a constant fuel-centerline temperature are calculated using steady-state heat-transfer calculations on a long fuel rod cooled externally by forced convection. Steady-state two-group neutron diffusion theory is used to predict the axial-fuel loading required to obtain the desired axial-power shape. Fuel loadings and neutron-flux distributions are presented for various axial-power shapes required in a reflected, water moderated, and cooled reactor. (auth) (STAR)

4406 (RISO-M-791) METHODS OF MEASURING REACTOR PARAMETERS BY AUTO- AND CROSS-SPECTRA STUDIES. Teodosi , Vlada (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug. 1968. 13p. (R-27-68). Dep.

A general discussion of the measurement and analysis of reactor noise, especially in the frequency domain, and the statistical accuracy of the results obtained is presented. Particular attention is paid to the possible use of the methods for determining the shutdown reactivity of power reactors. (auth)

4407 (RT/ING-(68)16) BEHAVIOR OF A FAST REACTOR IN PULSED OPERATION. Trombetti, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 24p. (In Italian). (PRV-r-(68)11). Dep.

A kinetic study of a fast pulsed reactor is performed in the case that the reactivity is a periodic function of time and the flux has reached an asymptotic quasi-periodic behaviour. The study is carried out in both cases of constant and non constant delayed neutron source. An evaluation of the conditions for the operation of the control system is given. Numerical results obtained by a computer code are also listed. (auth)

4408 TIME EIGENVALUES IN HYDROGEN GAS AND THEIR ANALYTIC ERROR ESTIMATES. Norman, Eugene; McCormick, N. J. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc., 11: 586 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4409 RESONANCE ABSORPTION IN FUELS WITH GRAIN STRUCTURE. Adir, Joel (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 593-4 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4410 IMPROVEMENTS ON A NEW METHOD FOR TIME-DEPENDENT TRANSPORT PROBLEMS. Tavel, M. A.; Zucker, M. S. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 557-8 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4411 VARIABLE BUCKLING CALCULATIONS FOR THERMAL WATER-MODERATED SYSTEMS BASED ON B-1 SPECTRA. Grimesey, R. A.; Curtis, R. L. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 11: 559 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4412 USE OF GROUP-SPACE-DEPENDENT BUCKLINGS TO SIMULATE A 3-D SPLIT-CYLINDRICAL REACTOR IN 2-D. Ulrich, A. J.; Beitel, J. C. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 560 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4413 AN ASYMPTOTIC P_3 THEORY. Lewis, E. E. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc., 11: 551-2 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4414 ELEMENTARY SOLUTIONS IN TWO-DIMENSIONAL TRANSPORT. Sotoodehnia, A.; Erdmann, R. C. (Univ. of California, Westwood). Trans. Amer. Nucl. Soc., 11: 552-3 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4415 SOLUTIONS OF THE ONE-SPEED NEUTRON TRANSPORT PROBLEM IN MULTILAYER SPHERES. Doctor, R. D. (Rand Corp., Santa Monica, Calif.); Erdmann, R. C. Trans. Amer. Nucl. Soc., 11: 553-4 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4416 THE CRITICAL PROBLEM FOR A TWO-REGION SPHERICAL REACTOR. Smith, O. J.; Siewert, C. E. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc., 11: 554-5 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4417 LATTICE PROBLEM IN ONE-SPEED NEUTRON TRANSPORT THEORY. Bond, G. R.; Siewert, C. E. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc., 11: 555-6 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4418 DIRECTIONS AND TRENDS IN REACTOR PHYSICS IN CANADA. Critoph, E. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 545 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4419 REACTOR PHYSICS TRENDS AND DEVELOPMENT IN FEDERAL GERMANY. Kuechle, M. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 545-6 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4420 RECENT REACTOR PHYSICS ACTIVITIES IN JAPAN. Oyama, A. (Tokyo Univ.); Nishihara, H.; Hirota, J. Trans. Amer. Nucl. Soc., 11: 546 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4421 REACTOR PHYSICS TRENDS AND DIRECTIONS IN THE UK. Mummery, P. W. (United Kingdom Atomic Energy Authority, Risley, Eng.). Trans. Amer. Nucl. Soc., 11: 547 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4422 NEW DIRECTIONS AND TRENDS IN REACTOR PHYSICS. Zartman, I. F. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 547 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4423 THE C_N METHOD OF APPROXIMATING BOLTZMANN EQUATION AND EXPONENTIAL EXPERIMENT PROBLEMS. Benoist, Pierre; Kavenoky, Alain (CEN, Saclay, France). Trans. Amer. Nucl. Soc., 11: 548 (Nov. 1968).

4424 THE C_N METHOD OF APPROXIMATING BOLTZMANN EQUATION AND CRITICAL PROBLEMS. Benoist, Pierre; Kavenoky, Alain (CEN, Saclay, France). Trans. Amer. Nucl. Soc., 11: 548-9 (Nov. 1968).

4425 NODAL MODEL FOR SPACE-DEPENDENT NUCLEAR REACTOR KINETICS. Alcouffe, Raymond E.; Albrecht, R. W. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc., 11: 569-70 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4426 TEMPERATURE FORMULATION OF THE REACTOR KINETICS EQUATIONS. Kurstedt, H. A. Jr. (Ohio State Univ., Columbus); Miley, G. H. Trans. Amer. Nucl. Soc., 11: 576 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4427 ON THE METHODS OF LYAPUNOV AND COMPARISON FUNCTIONS AND THEIR APPLICATION TO SPACE-DEPENDENT REACTOR KINETICS. Kastenberg, William E. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc., 11: 574-5 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4428 REACTOR PHYSICS EDUCATION AT THE TECHNOLOGICAL UNIVERSITY OF DELFT. Kleijn, H. R. (Univ. of Delft, Netherlands). Trans. Amer. Nucl. Soc., 11: 435-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4429 CRITICAL PARAMETERS OF PLUTONIUM SYSTEMS. Hansen, L. E.; Clayton, E. D. (Battelle Memorial Inst., Richland, Wash.). Trans. Amer. Nucl. Soc., 11: 671-2 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4430 METHODS OF RESOLVING INTERFACE AMBIQUITIES IN DISCONTINUOUS VARIATIONAL METHODS. Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc., 11: 529 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4431 VARIATIONAL DERIVATION OF DISCRETE-ORDINATE-LIKE APPROXIMATIONS. Natelson, N.; Gelbard, E. M. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 530-1 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4432 NEW SPATIAL DIFFERENCE EQUATIONS FOR TWO-DIMENSIONAL TRANSPORT. Lathrop, K. D. (Gulf General Atomic Inc., San Diego). Trans. Amer. Nucl. Soc., 11: 531-2 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4433 MONTE CARLO METHOD FOR REACTIVITY CHANGE DUE TO GEOMETRICAL PERTURBATION. Takahashi, Hiroshi (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 11: 533-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4434 A NUMERICAL METHOD FOR THE SOLUTION OF THREE-DIMENSIONAL NEUTRON-TRANSPORT PROBLEMS. Wagner, M. R. (Gulf General Atomic Europe, Zurich). Trans. Amer. Nucl. Soc., 11: 534-5 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4435 MAXIMUM EIGENVALUE IN THE PULSED-NEUTRON INITIAL-VALUE PROBLEM. Rodriguez, Pablo J.; Nguyen, Dong H. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc., 11: 578-9 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4436 ASYMPTOTIC STABILITY WITH POSITIVE MODERATOR REACTIVITY COEFFICIENTS. Sha, W. T.; Hsu, C. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 11: 572-3 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4437 GENERAL METHOD FOR CONSTRUCTING LYAPUNOV FUNCTIONS EMPLOYING FREQUENCY-DOMAIN CONCEPTS. Kalinowski, Joseph E.; Bailey, R. E. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc., 11: 573-4 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4438 DETERMINATION OF THE DYNAMIC COUPLING COEFFICIENT. Hassan, H. H. (Babcock and Wilcox, Lynchburg, Va.); Miley, G. H. Trans. Amer. Nucl. Soc., 11: 575-6 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4439 EFFECT OF THE DELAYED-NEUTRON SPECTRA UNCERTAINTIES ON FAST REACTOR DYNAMICS AND STABILITY. Yiftah, S.; Saphier, D. (Technion-Israel Inst. of Tech., Haifa). Trans. Amer. Nucl. Soc., 11: 568-9 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4440 SPACE-DEPENDENT DYNAMIC BEHAVIOR OF FAST REACTORS USING THE TIME-DISCONTINUOUS SYNTHESIS METHOD. Kessler, G. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 569 (Nov. 1968).
From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4441 VERIFICATION OF A XENON SPATIAL STABILITY CRITERION. Hooper, Richard J.; Rydin, Roger A.; Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucl. Sci. Eng., 34: 344-6 (Dec. 1968).
A xenon spatial stability criterion for large power reactors is described; some results which support the criterion are discussed. A summary of studies is shown graphically. (M.L.S.)

4442 ON THE USE OF DIFFERENT RADIAL TRIAL FUNCTIONS IN DIFFERENT AXIAL ZONES OF A NEUTRON FLUX SYNTHESIS COMPUTATION. Wachspress, E. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucl. Sci. Eng., 34: 342-3 (Dec. 1968).
Use of radial trial functions in different axial zones to avoid flux discontinuities is discussed. Combining coefficients are defined for the various axial zones; axial neutron leakage is defined in terms of matrix notation. (M.L.S.)

4443 ASYMMETRIC DISCONTINUITIES IN SYNTHESIS TECHNIQUES FOR INITIAL-VALUE PROBLEMS. Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 34: 343-4 (Dec. 1968).
The bases for use of asymmetric discontinuities at overdetermined interfaces are discussed. Functional notation is used to remove symmetry considerations. The expressions for neutron flux and adjoints are shown to possess properties of asymmetric discontinuities; trial function expansions are determined for treatment of these. (M.L.S.)

4444 OVERLAPPING GROUP METHODS WITH DISCONTINUOUS TRIAL FUNCTIONS. Becker, Martin (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 34: 339-41 (Dec. 1968).
The use of discontinuous overlapping groups without the requirement of staggered discontinuities for analysis of fast and thermal reactors is discussed. The energy dependent diffusion equation is developed for one dimensional geometry and generalized to multispace. Interface conditions are specified for small trial functions. (M.L.S.)

4445 THE CALCULATION OF NEUTRON FLUX RATIOS IN CRITICAL SYSTEMS BY THE INDIRECT VARIATIONAL METHOD. Pomraning, G. C. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng., 34: 308-12(Dec. 1968).

A discussion is given of the use of the indirect variational method for generating the trial functions needed to compute a variational estimate of a homogeneous functional of the solution to an eigenvalue equation. It is shown that one use of the method leads to no difficulties, whereas another use gives meaningless results. In this latter instance, the method of weighted residuals can be used to generate the necessary trial functions. With the trial functions known, the variational estimate of the functional of interest follows by quadrature. (auth)

4446 STREAMING EFFECTS AND COLLISION PROBABILITIES IN LATTICES. Benoist, P. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Sci. Eng., 34: 285-307(Dec. 1968).

In a previous publication by Benoist, a simple and general formulation of the streaming effect in lattices was established which defines the diffusion coefficients by a suitable weighting of the mean-free-paths of the various media; this formulation introduced special types of collision probabilities initially calculated by an iteration technique. However, it appeared better to work with a closed formulation as the series of angular correlation terms evidenced a very slow convergence, especially for large channels. This approach requires the solution of the Boltzmann equation with particular types of sources. This solution is shown to be equivalent to the treatment of a cell in terms of some fictitious reaction rates which are defined. The problem is essentially analogous to the calculation of the thermal utilization factor, an analogy that has been exploited as far as possible. Finally, by an adjustment on the corresponding void channel system, the treatment of fueled channels is made, and a new method is proposed for the direct treatment of the latter case. The new expressions obtained for the diffusion coefficients are very simple and the numerical results obtained with them agree very well with reference calculations made by a variational method which is also exposed. Various auxiliary corrections are studied; and, finally, formulas for practical utilization are given. (auth)

Experimental Applications

4447 (LA-3954) FISSION PRODUCT ENERGY RELEASE AND INVENTORY FROM ^{239}Pu FAST FISSION. Battat, M. E.; Dudziak, Donald J.; Hicks, H. R. (Los Alamos Scientific Lab., N. Mex.). Nov. 1967. Contract W-7405-eng-36. 30p. Dep. CFSTI.

By use of currently available experimental and calculated fission product yields from fast fission of ^{239}Pu, the fission product code, FPIC, has been expanded to include the capability of calculating fission product decay powers for ^{239}Pu fast fission. The revised code, FPIC/U-Pu, is operational on the CDC-6600 computer. Summation calculations of β, γ, and total decay powers from ^{235}U thermal fission and from ^{239}Pu fast fission were compared for both an instantaneous burst and infinite irradiation. Shutdown times ranged from 10 to 10^9 sec, and significant (>10%) differences occur principally for very short and very long shutdown times. The decay powers from ^{235}U thermal fission were compared with previous studies for an instantaneous burst and for infinite irradiation, and good agreement was found over the applicable shutdown times. Calculations of β, γ, and total fission product decay powers from ^{239}Pu fast fission for a specific irradiation history were then compared with the corresponding experimental measurements by K. Johnston of AWRE, as well as with ^{235}U thermal fission calculations. For γ and total decay power, the ^{239}Pu fast fission calculations generally agreed better with the experiment, whereas for β decay power, the ^{235}U thermal fission calculations were generally better. Similar conclusions were drawn from comparisons of instantaneous burst calculations with the corresponding analytical fits derived from the experimental data. (auth)

4448 NEUTRON SPECTRA MEASUREMENTS IN SODIUM AND STAINLESS STEEL. Paschall, R. K. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 11: 700-1(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4449 NEUTRON AGE AND INFINITE-MEDIUM NEUTRON MULTIPLICATION FACTOR FOR UF_4-PARAFFIN MIXTURES WITH LOW ^{235}U ENRICHMENT. Raffety, S. J. (Oak Ridge National Lab., Tenn.); Mihalczo, J. T. Trans. Amer. Nucl. Soc., 11: 676-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4450 PERTURBATION OF NEUTRON SPECTRA BY A BEAM EXTRACTION HOLE. Trimble, G. D.; Gozani, T.; Neill, J. M.; d'Oultremont, P.; Preskitt, C. A. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc., 11: 609-10 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4451 EFFECTS OF CONDENSATION ON REMOVAL OF FISSION PRODUCTS FROM STEAM-AIR MIXTURES. Ozisik, M. N.; Hughes, D. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc., 11: 667-8(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4452 CONTRIBUTION OF THE CONTINUUM TO THE NEUTRON TRANSIENT BEHAVIOR IN A PULSED MULTIPLYING CYLINDER. Nguyen, Dong H.; Rodriguez, Pablo J. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc., 11: 582-3(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4453 AUTOCORRELATION FUNCTION OF NEUTRONIC NOISE IN A NONLINEAR TIME-VARYING CASE. Velez, Carlos (Instituto Politechnico Nacional, Mexico). Trans. Amer. Nucl. Soc., 11: 564-5(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4454 EXPERIMENTAL INVESTIGATIONS ON U-D_2O LATTICES. Accinni, F. (CISE, Milan); Ciuffolotti, L.; Mangialajo, M.; Taddei, F. Energ. Nucl. (Milan), 15: 702-20(Nov. 1968). (In Italian).

A description of the uranium-D_2O subcritical assembly is given; the various lattice configurations used in testing are described. The following measurements are discussed: fast fission factor, resonance absorption, spectral indices and fine structure. Data from the tests are tabulated; experimental apparatus and procedures are described. Results of the tests are analyzed. 24 references. (M.L.S.)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 2318, 2696, 2711, 2725, 3022, 3038, 3058, 3107, 3108, 3112, 3113, 3116-3118, 3121, 3123, 3126, 3128, 3129, 3131-3134, 3139, 3146, 3155, 3158, 3901, 3902, 3907, 3908, 3911-3913, 3963, and 4164.

4455 (AECL-3115) ORGANIC REACTOR COOLANTS: AN APPARATUS PRODUCING DISPERSIONS IN WATER FOR TOXICITY TESTING. Acres, O. E.; Guthrie, J. E. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). July 1968. 15p. Dep. CFSTI. CAN $1.00.

A method for preparing suspensions of Santowax O. M., Santowax O. M. + 30% high boilers, HB-40, and HB-40 + 30% high boilers in water has been developed. The apparatus, method of operation, characteristics of the coolant suspensions, and effect of aeration on settling-out rate, are described. The settling rates of the suspensions are sufficiently uniform to allow their toxicity to fish and other aquatic organisms to be tested. The concentrations and settling rates of suspensions obtained by shaking HB-40 in water at room temperature are also reported. (auth)

4456 (AEEW-R-510) EROSION OF COMMON STRUCTURAL MATERIALS AND THE DEGRADATION OF SUSPENDED PARTICLES IN FLOWING SUSPENSION OF GRAPHITE POWDER IN CARBON DIOXIDE GAS. Garton, D. A.; Hawes, R. I.; Rose, P. W. (Atomic Energy Establishment, Winfrith (England)). June 1968. 26p. Dep. CFSTI. UK 5s. 0d.

Experiments were performed to examine the erosion of common materials of construction by a flowing suspension of graphite powder in carbon dioxide gas, and also the degradation of the graphite powder in the suspension. The suspension was circulated through a stainless steel loop at a pressure of 200 psig and bulk fluid temperature of 100-150°C. No change in the weight of pins of mild steel, stainless steel and Zircaloy, placed across the flow stream in a region where the velocity approached 100 ft/sec, could be detected after 350 hours of circulation. Examination of microphotographs of the cross sections of the specimens showed no change in the structure of the metals. Considerable erosion of graphite pins, producing a 6% decrease in the weight, was observed under similar conditions. Detailed spectrographic analysis of the suspended powder taken at various times during the

experiment showed no noticeable increase in the impurity content which could be attributed to erosion of the test specimens. A considerable increase in the tungsten, tin and cobalt concentrations was observed, and this is attributed to wear of the pump seal surfaces. The mean particle size of the suspended graphite powder was observed to decrease rapidly from 5 microns to 3 microns after only a few hours of circulation in the loop. After this initial period there was little further change in the particle size, the mean diameter being 2.85 microns after 167 hours of circulation. (auth)

4457 (ANL-Trans-690) MEASUREMENT OF THE VELOCITY AND TEMPERATURE OF A LIQUID METAL COOLANT. Subbotin, V. I.; Ibragimov, M. Kh.; Loginov, N. I. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from At. Energ. (USSR), 25: 150-1(1968). 3p. Dep. CFSTI.

An electromagnetic measurement method for investigating the hydrodynamic characteristics of complex channels which simulate the core of liquid metal cooled reactors is described. Small-scale flow meters used in combination with microthermocouples were developed, and results of experimental velocity and temperature measurements are presented. (H.D.R.)

4458 (ARH-600(Vol.1)) CRITICALITY HANDBOOK. VOLUME I. Carter, R. D.; Kiel, G. R.; Ridgway, K. R. (Atlantic Richfield Hanford Co., Richland, Wash.). June 30, 1968. Contract AT(45-1)-2130. 253p. Dep. CFSTI.

Topics discussed include: administration; engineering data; homogeneous systems; heterogeneous systems; interaction; and poisons. (D.C.C.)

4459 (GAMD-8415) PROPERTIES OF SILICON CARBIDE RELEVANT TO ITS PERFORMANCE AS A COATING FOR HIGH TEMPERATURE NUCLEAR FUEL PARTICLES. Price, R. J.; Gulden, T. D.; Kaae, J. L. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 1, 1968. Contract AT(04-3)-633. 21p. Dep. CFSTI.

The physical properties of SiC are described. Results are presented from a mathematical model analysis of the stress state in a composite coating of PyC-SiC on a fuel particle as a function of burnup and neutron radiation. (D.C.C.)

4460 (NP-17597, pp 7-39) BASIC RESEARCH. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

ACCELERATORS, RADIATION DETECTORS, BUBBLE CHAMBER — design characteristics of, summary of
FRANCE — research activities in nuclear energy, 1967 summary of
ELEMENTARY PARTICLES — research on, summary of French basic
PROTONS — diffusion of polarized, summary of French research on inelastic
COSMIC RADIATION, GEOPHYSICS, THERMONUCLEAR REACTIONS, PLASMA, RADIATION CHEMISTRY, RADIOBIOLOGY, MAGNETISM, NUCLEAR MAGNETIC RESONANCE — research on, 1967 summary of French (H.D.R.)

4461 (NP-17597, pp 109-35) PRODUCTION OF BASIC MATERIALS FOR THE NUCLEAR INDUSTRY. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — materials production for nuclear industry in, 1967 summary of
URANIUM, PLUTONIUM, TRANSURANIUM ELEMENTS, TRITIUM, WATER-D_2, GRAPHITE, ZIRCONIUM, HAFNIUM — production in France, 1967 summary of
RADIOACTIVE MATERIALS — transport in France, 1967 summary of (H.D.R.)

4462 (NP-17642) USE OF MASS-SPECTROMETRIC DATA FOR CALCULATION OF BURN-UP AND REACTOR CORE CONSTANTS. Bokelund, H. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Aug. 1968. 23p. (ETR-228). Dep.

Data from isotopic analyses of U and Pu in dissolver solutions have been used to calculate fuel burnup, integrated neutron flux, conversion factors and ^{235}U capture-to-fission ratio for some reactors fueled with natural or low enriched U. The relation between the calculated atom percent fission and the integrated neutron flux is presented as a linear graph. 9 references. (auth)

4463 (ORNL-TM-2034) REACTOR OPERATOR STUDY HANDBOOK (PROGRAMMED INSTRUCTION VERSION). VOLUME I. ELEMENTARY MATHEMATICS. Sheppard, S. D. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 155p. Dep. CFSTI.

Topics discussed include: fractions; analysis of problems; algebra review; logarithms; and use of the slide rule. (D.C.C.)

4464 (RT/ING-(68)12) PROGRAM FOR CALCULATION OF SUPPORT STRUCTURE OF THE FUEL ELEMENTS IN A NUCLEAR REACTOR. Curioni, S.; Rossi, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 29p. (In Italian). (PRV-r-(68)9). Dep.

The logical structure and the conditions of use of a computer program used to determine the tensions and the deformations in the support structure of the fuel elements in a nuclear reactor are presented. This program is written in Fortran IV; an example of output and the Fortran instruction list are reported in the appendixes. (auth)

4465 NUCLEAR FUEL ASSEMBLY. Rouge, Pierre; Roze, Michael; Vivien, Jean (to Commissariat a l'Energie Atomique). British Patent 1,132,919. Nov. 6, 1968. Priority date Dec. 12, 1966, France.

REACTOR FUEL ELEMENTS — assemblies of multiple clad pencil-type, description of parabola-shaped support grid for (D.C.C.)

4466 AXIAL-MECHANISM CONTROL ROD ACTUATOR. Pflugrad, Kurt (to Commissariat a l'Energie Atomique). British Patent 1,133,300. Nov. 13, 1968. Priority date Dec. 14, 1966, France.

REACTOR CONTROL ELEMENTS — drives for vertical, description of plug-penetrating tube-enclosed rotating coaxial grappler rod (D.C.C.)

4467 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Dale, Walter Bernard (to United Kingdom Atomic Energy Authority). British Patent 1,133,427. Nov. 13, 1968. Filed Mar. 8, 1967.

REACTOR CONTROL ELEMENTS — configuration of dual-zone movable black absorber with telescoping inner grey absorber, description of (D.C.C.)

4468 FUEL ELEMENT ASSEMBLY FOR NUCLEAR REACTORS. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,133,517. Nov. 13, 1968. Priority date Sept. 18, 1965, Germany.

REACTOR FUEL ELEMENTS — assemblies of multiple rod-shaped rib-separated bolt-secured, description of tube-enclosed (D.C.C.)

4469 SELECTION OF A URANIUM DILUENT ENRICHMENT FOR RECYCLED PLUTONIUM. Tulenko, J. S. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc., 11: 440-1 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4470 REACTOR NEUTRON FIELD MEASUREMENT. Muehlhause, C. O. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc., 11: 462-3 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4471 INTERACTION OF FISSION-GAS BUBBLES WITH STRUCTURAL DEFECTS AND RELEASE FROM NUCLEAR FUELS. Nichols, F. A.; Warner, H. R. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 11: 489-90 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4472 FUEL MICROSTRUCTURE VARIATION AS A CONSEQUENCE OF THE FIRST IRRADIATION PERIOD AND APPROACH-TO-POWER. Testa, G.; Calza-Bini, A.; Nobili, A.; Pugnetti, G.; Rotoloni, P. L. (CNEN, Rome). Trans. Amer. Nucl. Soc., 11: 494-5 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4473 IN-CORE MEASUREMENTS OF FUEL TEMPERATURES AND INTERACTION BETWEEN FUEL AND CLADDING. Kjaerheim, G.; Rolstad, E. (OECD, Halden, Norway). Trans. Amer. Nucl. Soc., 11: 496-7 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4474 THERMAL CONDUCTIVITY OF ThO_2-PuO_2 DURING IRRADIATION. Jeffs, A. T. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc., 11: 497-8 (Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4475 NATURAL-CONVECTION EFFECTS IN INSULATION OF PRESTRESSED CONCRETE VESSELS. Mordchelles-Regnier,

G.; Micheau, P.; Pirovano, A. (Bertin and Co., Plaisir, France). Trans. Amer. Nucl. Soc., 11: 656-7(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4476 NEW APPROACHES IN NONDESTRUCTIVE FUEL ASSAY USING INDUCED EMISSION OF GAMMA RAYS. Michaelis, W.; Horsch, F.; Leuschner, H.; Weitkamp, C. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc., 11: 663(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4477 FAILED FUEL ELEMENT DETECTION. Simanova, R. (Inst. of Nuclear Research, Prague). Jad. Energ., 14: 377-86 (Nov. 1968). (In Czech).

A general review of typical reactor fuel element failures is given as well as of methods used for their detection and localization. Special attention is paid to the methods of detection based on the release of fission radioisotopes of Xe and Kr with subsequent determination of their radioactivity or of the radioactivity of their solid daughter products. Application is indicated especially in gas cooled reactors and experimental reactor loops, and main parts of detection equipment and calibration methods are described. (auth)

4478 IMPROVEMENTS IN RADIATION SHIELDING. Parker, Horace Frank; Webb, John (to United Kingdom Atomic Energy Authority). British Patent 1,134,624. Nov. 27, 1968. Filed May 11, 1965.

REACTORS—shielding configuration with faces formed by hollow concrete walls filled with low-melting-point metals, reduction of temperature gradient by

SHIELDING—cooling of hollow-walled concrete, by natural connection of low-melting-point alkali metals (H.D.R.)

4479 QUARTZ AS AN EMITTER OF CHERENKOV RADIATION FOR POWER MEASUREMENT IN NUCLEAR REACTORS. Weiss, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 13: 408-14(Nov.-Dec. 1968). (In German).

The method of measuring reactor power by means of Čerenkov radiation is discussed. The requirements, that have to be met by a radiation emitter within the core, are stated. Pure quartz is best qualified among the materials which come into question as emitter for Čerenkov radiation. But it has a disadvantage due to the formation of color centers and luminescence caused by reactor radiation. Experiments showed that the application of higher temperatures accelerates the bleaching of color centers to such an extent that the equilibrium concentration of the color centers remains very low. Furthermore an increase in the bleaching rate was found owing to the reactor radiation. By means of the experimental data obtained a simplified mathematical expression for the irradiation- and bleaching process is derived which allows the calculation of the light emitted by the quartz as function of time, temperature and reactor power. Finaly the error of measurements is calculated for an assumed reactor and is compared to measurements taken during an investigation of a power measuring probe at the TRIGA reactor, Vienna. The results show good agreement. Furthermore the error of measurements in the power range is lower than with conventional measuring methods. (auth)

4480 FUEL ELEMENT. Fortescue, Peter; Bell, Francis R.; Duffield, Robert B. (to United States Atomic Energy Commission). U. S. Patent 3,413,196. Nov. 26, 1968.

A nuclear reactor fuel element is described which consists of a block of a refractory material having relatively good thermal conductivity and neutron moderating characteristics. The fuel element has a pair of parallel flat end faces and multiple sides which are substantially perpendicular to the end faces. The cross section of the block taken parallel to the end faces is of such a predetermined shape that multiple blocks can be interfitted together side-by-side to provide a continuous core array. The block contains multiple coolant holes which extend axially completely therethrough from end face to end face, and the block also contains multiple fuel chambers for holding nuclear fuel material. (auth)

4481 DEVICE FOR MEASURING THE DEPOSITION OF SOLIDS IN NUCLEAR REACTORS. Fitzpatrick, V. F. (to United States Atomic Energy Commission). U. S. Patent 3,411,987. Nov. 19, 1968.

A special nuclear fuel element for measuring the deposition of solids on fuel element surfaces in nuclear reactors is described. A core which is highly enriched in ^{235}U, ^{233}U or ^{239}Pu is surrounded by a heavy cladding of nonfissionable material having a fairly high capture cross section for neutrons. This gives substantially constant heat generation over a long period of time. A thin jacket surrounds the cladding. A thermocouple between the jacket and the cladding measures the temperature at that point. Increases in the difference between this temperature and the temperature of the coolant surrounding the device indicate the amount of deposition on the fuel element surface. (auth)

4482 BROADER APPROACH TO BENEFITS FROM NUCLEAR POWER AND ASSOCIATED SOCIAL AND OTHER COSTS. Phillips, M. Atom, No. 145, 297-306(Nov. 1968).

The subject is discussed under the following headings: introduction; demands on manpower; demands on capital; foreign exchange; assurance of supplies; technological spin-off—creation of intellectual capital; effects on environment; safety of general public; waste, including air pollution; and conclusions. (UK)

4483 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Wright, James Rostron; McFall, Albert (to United Kingdom Atomic Energy Authority). British Patent 1,134,698. Nov. 27, 1968. Filed June 28, 1965.

REACTORS, LIQUID METAL-COOLED—coolant voiding by fission gas release in, hydraulic counterflow brake for prevention of

BRAKES—configuration of hydraulic counterflow, for prevention of voiding in liquid metal-cooled reactor coolant inlet plenum

REACTOR SAFETY—coolant-void prevention in liquid metal-cooled reactors, hydraulic counterflow brake for (H.D.R.)

GENERAL

4484 (AAEC/E-192) SUBROUTINE SOK: ITERATIVE SOLUTION OF LINEAR EQUATIONS BY THE METHOD OF AVERAGING FUNCTIONAL CORRECTIONS. Pollard, J. P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1968. 29p. Dep.

The subroutine SOK solves a set of N simultaneous linear equations by an essentially iterative method. For the method to converge at a reasonable rate (or at all) the user must choose K(≤N), the order of subsidiary equations which are to be obtained from the N given equations. The matrix of coefficients of the K subsidiary equations is inverted using the direct method of Gauss-Jordan. The method is most effective on large sparse matrices that have dominant diagonal terms and for this situation it should be possible to choose K a lot less than N. The method is most advantageous compared to other iterative methods when the trial investigation of typical matrices is worthwhile. For large matrix problems, details are given of a possible compact matrix storage arrangement. For very large matrices, which even when compacted cannot fit in core, the solution procedure is feasible, provided the matrix is available from disk or tape a column at a time. The subroutine is written in FORTRAN for the IBM 360/50 computer. (auth)

4485 (ABCC-TR-7-66) RELATIONSHIP OF LACTIC DEHYDROGENASE ISOZYMES TO THE METABOLISM OF CULTURED HUMAN LEUKOCYTES. Bloom, Arthur D.; Wajima, Takeshi; Hamilton, Howard B. (Atomic Bomb Casualty Commission, Hiroshima (Japan)). Apr. 14, 1966. 10p. Dep. CFSTI.

The changing patterns of lactate dehydrogenase (LDH) activity in primary cultures of human leukocytes were related to cell metabolism and mitotic activity. The dominance of LDH-1 and LDH-2 in noncultured leukocyte suspensions and after the first 24 hours of culture was followed by a shift at 48 to 72 hrs to a pattern in which LDH-3 and LDH-4 significantly increased. The rise in M subunits occurred at the same time as increased numbers of transformed cells and of cells in active mitosis appeared in culture. The level of glucose in the medium fell throughout culture, while the levels of pyruvic and lactic acids maximally increased in the 48 to 72 hr period. Together with the gradual decrease found in oxygen content, these changes suggest that the major energy source early in culture is from aerobic metabolism, while anaerobic glycolysis appears to be the dominant metabolic process late in culture, when the shift to the cathodal bands takes place. The variable response of these cultures to oxygen supplementation is presented. (auth)

4486 (AE-335) SOLUTION OF LARGE SYSTEMS OF LINEAR EQUATIONS IN THE PRESENCE OF ERRORS. A CONSTRUCTIVE CRITICISM OF THE LEAST SQUARES METHOD. Nygaard, K. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Oct. 1968. 28p. Dep.

From the point of view that no mathematical method can ever minimize or alter errors already made in a physical measurement, the classical least squares method has severe limitations which makes it unsuitable for the statistical analysis of many physical measurements. A new method is developed for solving large systems of linear equations. It is based on the assumptions that the experimental errors are characteristic for each single experiment and that the errors must be properly estimated rather than minimized. The new method exposes the entire range of possible solutions before the decision is taken which of the possible solutions should be chosen as a representative one. The choice is based on physical considerations which (in two examples, curve fitting and unfolding of a spectrum) are presented in such a form that a computer is able to make the decision. A description of the computation is given. The method described is a tool for removing uncertainties due to conventional mathematical formulation (zero determinant, linear dependence) and which are not inherent in the physical problem as such. The method is therefore especially well fitted for unfolding of spectra. (auth)

4487 (AEC-tr-6993) PRINCIPAL ASPECTS OF FUEL-POWER BALANCE IN USSR. Beshchinskii, A. A.; Vigdorchik, A. G.; Makarov, A. A.; Rubin, M. A.; Saatchyan, L. O.; Shtengauz, E. O. Translated from paper No. 56 of 7th World Power Conference, Moscow, August 20-24, 1968. 17p. Dep. CFSTI.

Present and future production of various kinds of energy and fuel is estimated. The principal factors influencing the fuel and power balance are analyzed. Possible technical developments in heat and power generation, the means of supply to consumers, as well as some trends in the utilization of individual kinds of energy and fuel in the national energy balance are described. The importance of maintaining the leading rate of increase of electrical energy production relative to all other production is stressed. On the base of the analysis of comparative efficiency, the future pattern of efficient consumption of various forms of energy by main consumer groups is determined. The changing conditions of extraction, generation and transport of fuels and energy are examined. The results obtained from optimizing the future development of the USSR's fuel and power economy, and the possibilities of improving the pattern of the country's future energy balance are described. The particular features of power supply to the European regions of the USSR and the Urals are given serious consideration. (auth)

4488 (ANL-Trans-566) ANALYSIS OF THE PHYSIOLOGICAL MECHANISMS OF THE LIFE SPAN OF MAMMALS. Arshavskii, I. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Tr. Mosk. Obshchest. Ispyt. Prir., Otd. Biol., 17: 72-85(1966). 20p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Evidence collected over many years led to the conclusion that the ontogenetic development of the musculature is the major factor influencing the life span of various species of mammals. Factors discussed include the static or tonic component of the load upon skeletal musculature of the increasing linear dimensions of the organism in the course of its growth as opposed to the forces of the gravitational field, and the dynamic or phasetetanic component of the load upon the skeletal musculature connected with the performance of the respective working activity according to the peculiarities of ecology. Of substantial significance is the dynamic component that determines the scope of energy expenditures and the level of activity of the respiratory and cardiovascular system in the resting condition. The lower the level in the resting condition, the higher the working potentials of the organism in the medium, and respectively, the length of the life cycle of the developing organism. (auth)

4489 (ANL-Trans-569) ON THE PROBLEM OF PHYSIOLOGICAL MECHANISMS DETERMINING THE APPEARANCE OF AROMORPHOSES AND IDIOADAPTATIONS ACCORDING TO A. N. SEVERTSOV. Arshavskii, I. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Zool. Zh., 45: 1308-22 (1966). 20p. Dep. CFSTI. JCL $2.60 fs, $1.10 mf.

Data are presented on changes in the energetics (oxygen consumption level at the resting state), as well as the development and transformation of the activity of the respiratory and circulatory systems during postnatal ontogenesis in various mammalian species. Contrary to the energy law of the surface, the energy law of skeletal muscles is put forth. This law is regarded as one of the main factors determining peculiarities of the individual development of the organism and the different range of the potential lability of various systems of mammalian organs. This law is discussed as a possible physiological mechanism in the appearance of the idioadaptation (stenobiontness) or aromorphoses (eurybiontness) states. (auth)

4490 (BMI-171-014) SHRIMP FISHERY OF PANAMA. Bioenvironmental and Radiological-Safety Feasibility Studies, Atlantic-Pacific Interoceanic Canal. de Arauz, Reina Torres (Battelle Memorial Inst., Columbus, Ohio). Mar. 29, 1968. Contract AT(26-1)-171. 16p. Dep. CFSTI.

The habitats and distribution of Panama shrimp are described. The three fishery areas or zones are geographically delineated. The shrimp species harvested in Panamanian waters were listed as camarón blanco (white shrimp) Penaeus stylirostris, P. vannamei, P. occidentalis, and P. californiensis; camarón rojo (pink shrimp) P. brevirostris; camarón titi gris (titi gray shrimp) Xiphopenaeus riveti; camarón titi blanco (titi white shrimp) Protrachipeneus precipua; and camarón carabali (tiger or indio shrimp) Trachypenaeus byrdi and T. faoi. The methods of catch and processing are briefly enumerated. The economic importance of Panama's shrimp production in relation to exporting and local sale of catch, government regulations, catch data, and shrimping statistics by area are discussed. (B.S.L.)

4491 (BNL-12496) CONFORMATION STUDIES ON THE NEUROHYPOPHYSEAL HORMONE OXYTOCIN AND ITS ANALOGS. Walter, Roderich; Gordon, Wolfgang; Schwartz, I. L. (Mount Sinai Medical and Graduate Schools, New York. Dept. of Physiology. Brookhaven National Lab., Upton, N. Y.); Quadrifoglio, F.; Urry, Dan W. (American Medical Association Education and Research Foundation, Chicago, Ill. Inst. for Biomedical Research). [1968]. 10p. (CONF-680445-1). Dep. CFSTI.

From 9th European Symposium on Peptides, Orsay, France.

The effect of substituting one or both sulfur atoms by selenium on the biological activity of deamino-oxytocin was explored. Circular dichroic and uv absorption studies were carried out to determine whether topological differences between molecules could account for observed differences in activity. (TSL)

4492 (CLM-Bib-8) CULHAM LABORATORY REPORTS AND OTHER UNCLASSIFIED PUBLICATIONS ISSUED UP TO AUGUST 1968. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Sept. 1968. 17p. Dep.

4493 (COO-1668-8) MECHANISMS OF ION TRANSPORT AT THE SUBCELLULAR LEVEL WITH SPECIAL EMPHASIS ON THE ACTION OF PARATHYROID HORMONE. Progress Report, September 1, 1967-September 1, 1968. [DeLuca, Hector F.] (Wisconsin Univ., Madison. Dept. of Biochemistry). Sept. 26, 1968. Contract AT(11-1)-1688. 7p. Dep. CFSTI.

The effects of vitamin D, parathyroid hormone, and thyrocalcitonin on serum calcium and phosphate metabolism were studied Removal of the thyroid and parathyroid glands resulted in a low serum calcium that was elevated by parathyroid hormone or depressed by calcitonin. When rats were maintained on 20,000 i. u. of vitamin D per day and a low calcium diet, plasma calcium remained normal even after removal of both the thyroid and parathyroid glands. However, the plasma calcium level was very sensitive then to small amounts of parathyroid hormone and larger than normal amounts of exogenous calcitonin were needed to bring about a reduction in plasma calcium. It is believed that vitamin D induces the formation of a calcium transport substance which functions at the bone side of osteoclasts and osteocytes. When rats were given 40,000 i. u. of vitamin D per day and the glands were removed, both plasma calcium and phosphate rose to high values, resulting in death of some rats. The rise in plasma calcium and phosphate could be prevented by thyrocalcitonin, but the rise in plasma phosphate could not. The administration of both parathyroid and calcitonin was necessary to prevent the rise in plasma phosphate. A technique for intestinal perfusion experiments is described; it was demonstrated that the effect of vitamin D was to cause a two to five fold increase in the rate of calcium transport against a concentration gradient. The mechanism of calcium transport in the intestine was studied using in vitro preparations. Using flux chambers and short circuit experiments it could be shown that vitamin D did not change the flux ratios but increased the flux in both directions. It was demonstrated that vitamin D was converted to 25 hydroxycholecalciferol before producing its effects on calcium transport by the intestine and mobilization of bone. (H.L.W.)

4494 (ICRU-11) RADIATION QUANTITIES AND UNITS. (International Commission on Radiation Units and Measurements, Washington, D. C.). Sept. 1, 1968. 16p. ICRU Publications, Washington, D. C., $1.00.

The suggestions of the ICRU on radiation quantities and units are presented. (B.G.D.)

4495 (IN-1219) BIBLIOGRAPHY OF LASER PUBLICATIONS OF INTEREST TO EMISSION SPECTROSCOPISTS. Baldwin, Jon M. (Idaho Nuclear Corp., Idaho Falls). Oct. 1968. Contract AT(10-1)-1230. 19p. Dep. CFSTI.

Two hundred and fifty-eight references covering the period to July 1, 1968 are presented in three sections: laser beam interactions with gases, laser beam interactions with condensed phases, and laser applications to spectrographic analysis. (M.C.G.)

4496 (K-1760) BACTERIOPHAGE POPULATIONS IN NATURAL WATER. Lammers, William T. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 7, 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

The application of centrifugal methods of concentrating and isolating small particles has increased the sensitivity of viral assays by approximately two orders of magnitude. With these methods, developed and applied in the Biophysical Limnology Laboratory, it was possible to investigate the numbers, seasonal variations, and correlation of bacteriophage particles contained in samples of water from Poplar Creek that receives sewage from the eastern section of the city of Oak Ridge. Samples from two locations, 6.4 and 19.3 km downstream from the sewage effluent point of entry, were centrifugally isolated and studied. This year-long study of bacteriophage populations yielded results, especially statistical correlations, that may help in assessing the behavior of these particles in water and that emphasize the importance of further investigation of natural virus populations. (auth)

4497 (LA-3891) SOME INDIVIDUAL ION CORRELATIONS AMONG AQUEOUS FREEZING POINT MEASUREMENTS. Elliott, Guy R. B. (Los Alamos Scientific Lab., N. Mex.). June 1968. Contract W-7405-eng-36. 40p. Dep. CFSTI.

The experimental basis for thermodynamic solution theory is discussed, and a revised application of Debye-Hückel theory to the solvent behavior is examined. Over much of the concentration range of freezing point measurements for 1-1 electrolytes (up to approximately 1.2 molal, but excluding the most dilute solutions), the freezing point depressions, θ, can be described by equations of the form $\theta = \theta^{st} + k_1^* m + b_1^* m^2$, where θ^{st} is derived from Raoult's law plus Debye-Hückel interactions, m is molality, and k_1^* and b_1^* are constants. The experimental values of k_1^* and b_1^* for 1-1 salts of strong acids can be correlated through empirical individual ion parameters, which can be added to give approximate values of k_1^* and b_1^*. With few exceptions, the calculated and experimental values agree well. The 2-2 electrolytes appear to obey the same equation form in dilute solutions but to show changes in the constants at about 0.05 molal. Alcohol solutes also lead to a similar behavior except that θ^{st} is replaced by a simple Raoult's law term. (auth)

4498 (NP-17597) ANNUAL REPORT, 1967. (Commissariat a l'Energie Atomique, Paris (France)). 227p. (In French). Dep.

The activities of the French Atomic Energy Commission are summarized for the year 1967. A separate abstract was prepared for each of the 14 sections included in the summary. (H.D.R.)

For abstracts of individual sections see: 2518, 2821, 3315, 4171, 4316, 4460, 4461, and 4499-4505.

4499 (NP-17597, pp 83-95) MILITARY APPLICATIONS. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — research activities on military applications of nuclear energy, 1967 summary of

PHYSICS, METALLURGY, CHEMISTRY, RADIOCHEMISTRY, ELECTRONICS, RADIATION PROTECTION — research on military applications of, 1967 summary of French (H.D.R.)

4500 (NP-17597, pp 167-75) EFFICIENCY AND ORGANIZATION OF THE COMMISSARIAT A L'ENERGIE ATOMIQUE. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — organizational structure of C. E. A., 1967 summary of

PERSONNEL — organizational structure of French C. E. A., 1967 summary of (H.D.R.)

4501 (NP-17597, pp 177-85) FINANCES. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — financial report of C. E. A. for 1967 (H.D.R.)

4502 (NP-17597, pp 187-91) RELATIONSHIP OF THE C.E.A. WITH INDUSTRY. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — relationship of C. E. A. and industry during 1967

LICENSING AND REGULATION — activities of French C. E. A. during 1967 (H.D.R.)

4503 (NP-17597, pp 193-205) INTERNATIONAL AND PUBLIC RELATIONS. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — international and public relations of C. E. A. during 1967 (H.D.R.)

4504 (NP-17597, pp 207-13) INSTRUCTIONS. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — educational and information activities of C. E. A. during 1967

PERSONNEL — training activities of French C. E. A. during 1967 (H.D.R.)

4505 (NP-17597, pp 215-27) ORGANIZATION CHARTS AND COMPOSITION OF THE COMMITTEES, COUNCILS, AND COMMISSIONS CONSULTING WITH THE C.E.A. (Commissariat a l'Energie Atomique, Paris (France)). (In French).

FRANCE — composition of government organizations consulting with C. E. A. during 1967 (H.D.R.)

4506 (ORNL-4331) GENERALIZED MULTI-DIMENSIONAL AGE-DEPENDENT BRANCHING PROCESS. Mode, Charles J. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 51p. Dep. CFSTI.

In the classical age-dependent branching process of Bellman and Harris (Harris (1963)) the death and the production of offspring by an individual coincide. For many biological applications, however, it is necessary to consider a model in which an individual may give birth to offspring at random points of time during his life-span. A generalized multi-dimensional age-dependent branching process is a stochastic model for the growth of a population of particles (individuals) which may produce new individuals (particles) at random points during their

life-span and each individual may belong to one of a finite number of types. Such processes have applications in both biology and physics. Applications of the process to the dynamics of cell populations and population genetics are included. The results presented combine and extend the results presented in Mode (1968 a,b) and Crump and Mode (1969 a,b). (auth)

4507 (ORNL-TM-2367) LANGUAGE OF NUCLEAR SCIENCE. Kertesz, Francois (Oak Ridge National Lab., Tenn.). Sept. 17, 1968. Contract W-7405-eng-26. 35p. Dep. CFSTI.

The wartime code words and the more recent special terms used in the nuclear literature and engineering trade jargon are reviewed. (M.C.G.)

4508 (ORNL-tr-1798) RESEARCH ON THE DNA OF K RAT VIRUS (PARVOVIRUS RATTI). May, Pierre; Niveleau, Alain; Berger, Gerard; Brailovsky, Carlos. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from J. Mol. Biol., 27: 603-14(1967). 13p. Dep. CFSTI.

Results are reported from electron microscopic and biophysical studies on the DNA of a purified preparation of the K rat virus (parvovirus ratti). The DNA was found to be infectious. Data on its molecular weight and structure are reported. (C.H.)

4509 (RISO-M-756) MULTIPLE 4-QUADRANT MULTIPLIER; 1-QUADRANT MULTIPLIER. Hoejberg, K. Soee (Danish Atomic Energy Commission, Risoe. Research Establishment). May 1968. 8p. (R-18-68). Dep.

By means of the multiple 4-quadrant multiplier program a digital computer can be used as conventional analog multipliers. The operations performed are $z = xy$, $z_1 = x_1y_1 \ldots z_n = x_ny_n$. By means of the 1-quadrant multiplier program a digital computer can be used in a similar way as a conventional analog multiplier for the operation $z = xy$. (Denmark)

4510 (TID-3916) SCIENCE AND SOCIETY. A Bibliography, 1965-1967. Voress, Hugh E. (Division of Technical Information (AEC), Washington, D. C.). July 1968. 87p. Dep. CFSTI.

Subject Index by Hugh E. Voress.

A bibliography of five hundred and ten references on the general topic of changes wrought by the advances of science on man and his social organizations is presented. A subject index is also included. (B.G.D.)

4511 (UCRL-Trans-10204) TANTALUM FOR SKULLCAP REPAIR. Wiebeck, Bodo-Heinz. Translated by F. S. Freisinger for Univ. of California Lawrence Radiation Lab., Livermore, from Aerztl. Forsch., 3: 71-2(1949). 9p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

On the basis of surgical experience gained in the U.S.A., the advantages of the use of tantalum for the repair of injuries of the human skull are described. The operative technique involved in the insertion of a tantalum cover plate, as well as the necessary preparations for insertion are also described. (auth)

4512 (UCRL-Trans-10212) TIME OF MATURATION, DURATION OF MITOSIS, AND DAILY EXCHANGE OF GRANULATED LEUCOCYTES. Moeschlin, Sven. Translated by F. S. Freisinger for Univ. of California Lawrence Radiation Lab., Livermore, from Schweiz. Med. Wochensch., 76: 1051-3(1946). 17p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The time required for the maturation of granulocytes in man was shown experimentally (stimulation of the bone marrow with Pyrifer) to be 8 to 10 days. This result was confirmed by other observations concerning cases of agranulocytosis and also a case representing an isolated pernicious anemia of the white-blood cell system. Further support for these findings was obtained from studies on the course followed by the granulocytic crisis developing after splenectomy owing to the loss of the splenogenic inhibition of the bone marrow. On the basis of the maturation time established above, some calculations were carried out on the duration of mitosis, the daily production of granulocytes, and the total granulocyte exchange. (auth)

4513 (Y-1620) COMPUTER PROGRAMS FOR DETERMINING PAYOUT-EYE POSITIONS FOR LAYING FILAMENTS ALONG GEODESIC PATHS ON SURFACES OF REVOLUTION. Bookhart, T. W.; Fowler, A. H. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Nov. 13, 1968. Contract W-7405-eng-26. 56p. Dep. CFSTI.

Fortran computer programs have been written for determining a geodesic path on an arbitrary surface of revolution. For this geodesic path on the surface, the corresponding payout-eye locations are calculated so that a machine will lay the filament along this geodesic path. Mandrel geometry and eye clearance are considered in locating the payout eye. The output of the program is a listing of points along the surface and the corresponding payout-eye positions. This information is then processed by an APT postprocessor to produce a punched tape for a numerically controlled filament winder. (auth)

4514 (Y-1660) GEODESIC PATHS ON SURFACES OF REVOLUTION: A COMPUTER-AIDED FILAMENT-WINDING DESIGN PROGRAM. Bookhart, T. W.; Fowler, A. H. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Nov. 20, 1968. Contract W-7405-eng-26. 90p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Fortran computer programs have been written that will determine the geodesic paths on an arbitrary surface of revolution. The programs can also determine the number of circuits of the geodesics necessary to produce a wrap of a specified thickness. This thickness can be for one geodesic or be the cumulative buildup of many geodesics. Once the geodesic paths are determined, thickness profile and helix angle plots are produced. In addition, routines are available for plotting the geodesic paths on the developed surface giving a two-dimensional picture of the paths on the surface. (auth)

4515 ANALYZING AN ELECTION ON ELECTION NIGHT. Fang, Irving E. (American Broadcasting Co., New York). Trans. Amer. Nucl. Soc., 11: 527(Nov. 1968).

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C. See CONF-681101.

4516 THE INTERNATIONAL CONFERENCE ON THE CONSTRUCTIVE USES OF ATOMIC ENERGY, NOVEMBER 10-15, 1968, WASHINGTON, D. C. Farmakes, Ruth (ed.). Trans. Amer. Nucl. Soc., 11: 425-709(Nov. 1968). (CONF-681101).

The transactions include summaries of 320 papers. Each paper is listed in NSA. (D.C.C.)

For abstracts of individual papers see: 2222-2232, 2277, 2336, 2337, 2364, 2395-2399, 2443-2455, 2475-2480, 2501-2508, 2524-2529, 2535, 2547, 2567-2573, 2635, 2667, 2668, 2682, 2710-2714, 2751-2753, 3013, 3024-3026, 3035, 3052, 3093-3101, 3115-3121, 3150, 3151, 3161, 3544-3547, 3872, 3873, 3900-3914, 4013-4018, 4148-4157, 4161, 4175, 4183-4194, 4199, 4200, 4207, 4208, 4224-4257, 4261-4263, 4265-4268, 4277-4287, 4291, 4321-4378, 4392-4395, 4397, 4400, 4401, 4408-4440, 4448-4453, 4469-4476, and 4515.

4517 AEC AUTHORIZING LEGISLATION, FISCAL YEAR 1967. PART 3. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-EIGHTH CONGRESS, SECOND SESSION ON BIOLOGY AND MEDICINE; TRAINING, EDUCATION, AND INFORMATION; PLOWSHARE; ISOTOPES DEVELOPMENT; PHYSICAL RESEARCH; COMMUNITIES; AND AEC ADMINISTRATIVE PROGRAMS, FEBRUARY 20, 25, 26, 27; MARCH 2 AND 3, 1964. Washington, D. C., Joint Committee on Atomic Energy, 1966. 1006p. GPO $3.00.

A report on hearings before Joint Committee on Atomic Energy on February 20, 25, 26, 27; and March 2 and 3, 1964 is presented. The report includes statements by Atomic Energy Commission witnesses, statements of other witnesses, statement submitted for the record, additional materials submitted for the record, correspondence inserted in the record, and various appendixes. (B.G.D.)

4518 THE NUCLEAR INDUSTRY. Washington, D. C., Atomic Energy Commission, 1968. 267p. GPO $2.00.

Progress in the peaceful applications of nuclear energy during 1968 is summarized. The nuclear industry highlights which are discussed include: civilian nuclear power; private ownership of nuclear material; enrichment; safeguards; radioisotopes; Plowshare; spin-off; licensing and regulation; legal aspects; and international activities. Extensive charts and tables are included. (H.D.R.)

4519 SVENSK NATURVETENSKAP 1968. (Swedish Natural Sciences 1968). Afzelius, Bjoern (ed.). Solna, Sweden, Statens Naturvetenskapliga Forskningsrad, 1968. 314p.

Reviews are given on research going on in different areas of natural sciences in Sweden. (Sweden)